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CONTENTS

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
- Sixth Annual Meeting, Pacific Coast Gas Association 81
- Wrinkle Department, Pacific Coast Gas Association 81

EDITORIALS—
- Briefly Told 82
  - The Sixth Meeting of the Pacific Coast Gas Association—An English Example of the Difference Between a Gas and Electric Lighting Installation—Notes.
- Washers and Scrubbers, by Mr. E. A. Harman 82
- Electric Utilization of Water Powers, by Mr. L. D. W. Magie 86
- Anxious Moments in a Gas Manager's Day, by an "Old One" 87
- Some German and French Experiments regarding the Ignition of Gas in Coal Mines by Electrical Apparatus 88
- Two Recent Decisions Concerning Riparian Rights 89
- Preliminary Note on the Action of Light on Acetylene 90
- The Molder of the Future and the Need of an Adequate Apprenticeship System, by Mr. P. W. Gates 90

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 92
- A Hint from New Orleans, La.—Contract for the Berlin Iron Bridge Co.—Proposed Company for Milford, Pa.—The Beginning of the End at Memphis, Tenn.—New Generating Plant for the Binghamton (N. Y.) Company—Annual Meeting, Mankato, Minn.—New Office Quarters for the Detroit Company—Annual Meeting, Milwaukee, Wis.—Gas Rates at Wilkes-Barre, Pa.—Annual Meeting, Louisville, Ky.—A Mysterious Gas Company—Annual Meeting, Burlington, Vt.—Will Atkinson, Wis., Have an Acetylene Plant?—Proposed Works for Torrington, Conn.—Public Lighting, Freehold, N. J.

The Market for Gas Securities 93

[OFFICIAL NOTICE.]

Sixth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY, OAKLAND, CAL., June 6, 1898.

The sixth annual convention of the Pacific Coast Gas Association, Mr. F. H. Eichbaum, President, will be held in San Francisco, on Tuesday and Wednesday, July 19 and 20, 1898, in the office building of the San Francisco Gas and Electric Company; morning sessions, from 10:15 to 12:30; afternoon sessions, 2 to 4:30. The Board of Directors will meet on Monday, July 18, at 8 P.M., at headquarters, which are hereby established at office of Mr. E. C. Jones, Chief Engineer San Francisco Gas and Electric Company, No. 413 Post street.

Copies of all papers, questions and applications for membership must be mailed to Secretary prior to July 18. Members to whom questions are assigned are requested to send answers promptly.

Papers will be submitted by the following members, on subjects to be announced:

E. C. Jones, San Francisco, Cal.; C. O. Poole, San Francisco, Cal.; John L. Howard, San Francisco, Cal.; O. M. Gregory, San Jose, Cal.; F. Foveaux, San Francisco, Cal.; John A. Britton, Oakland, Cal.; W. M. Parker, Bellingham Bay, Wash.; A. Gutsch, Fresno, Cal. In addition to his address as President, Mr. Eichbaum will continue his "Reminiscences."

The question of the change of name of the Association, from that of the Pacific Coast Gas Association to that of the Pacific Coast Gas and Electric Association, will come up for final action.

Mr. George H. Hollidge, of Merced, Cal., has charge of "Wrinkles," and Mr. John Clement, of Red Bluff, Cal., is directing the "Experiences." It is hoped the members will contribute liberally to both of these departments.

An excursion is arranged for Thursday, July 21, particulars of which will be hereafter announced.

The Secretary has on hand a number of bound copies of the "Proceedings," which are purchasable at $2 per copy.

JOHN A. BRITTON, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Pacific Coast Gas Association.

MERCED, CAL., March 11, 1898.

To the Members of the Pacific Coast Gas Association: At the last meeting of the Pacific Coast Gas Association to me was delegated the duty of collecting and presenting any matter, in the shape of original ideas or special devices, which may come under the head of "Wrinkles," to be presented in proper form for the benefit of the Association at the next regular assembly.

Many of our members having charge of gas plants on the Coast have many plans, that are practical, handy and labor-saving, which many others by force of circumstances have never seen, but who, on presentation of the device, drawn and described, or through the medium of our official organ (the AMERICAN GAS LIGHT JOURNAL), would gladly embrace the opportunity, and put into practice a plan very beneficial—

which perhaps had been in use in some obscure place many years, used exclusively by one man—that would, when given daylight, benefit the whole gas fraternity.

On reading this communication, please see if you have not forgotten something in the shape of a "Wrinkle," that is doing good service in your works, that would be of great importance to the Association. Your answer to this will greatly oblige.

GEORGE H. HOLLIDGE,
Editor "Wrinkle" Department.

BRIEFLY TOLD.

THE SIXTH MEETING OF THE PACIFIC COAST GAS ASSOCIATION.—If careful attention to the duties carried by their positions means success, it must be said that the sixth meeting of the Pacific Coast Gas Association cannot be other than a complete success, for President Eichbaum, Secretary Britton, Editor Hollidge and the local committee have left nothing undone that should have been done towards causing the sessions to be profitable and instructive to those who will attend them. This judgment applies as well to the social as to the technical side of the convention, and so enough has been said to warrant the belief that a right good attendance will reward the executives for the fraternal exertions they have put forth. We are not aware that the paper list has been added to over the numbers that have been printed in our official notices of the meeting, but we have the satisfying assurance that Editor Hollidge has collected a large list of "Wrinkles," some of which, paradoxical as it may seem, are well calculated to do away with those frownings that occasionally appear on the gas man's features. The outing programme has been most skilfully arranged, and perhaps it is not telling too much out of school when it is remarked that in this division of the preliminaries the master hand of Mr. E. C. Jones has been very much in evidence. In the next issue of the JOURNAL we hope to give a special telegraphic *resume* of that which occurred at the Coast Association's sixth meeting.

AN ENGLISH EXAMPLE OF THE DIFFERENCE BETWEEN A GAS AND AN ELECTRIC LIGHTING INSTALLATION.—In an editorial comment in a recent issue of the *Gas World* we find it stated that in the brisk and pretty watering place of Blackpool, England (the gas and electric supply of which is in the control of the local authority), there are 8,200 consumers of gas, and the highly profitable works from which they obtain their supply of gas represent an expenditure of $56.25 per consumer. The electric undertaking on the other hand, although it has been only a few years in existence, represents a cost, including an expenditure of $200,000 now in contemplation, of $1,105 per consumer, taking the number of consumers at 600, which is said to be a liberal estimate. These and other figures complimentary to the gas undertaking, and the reverse of complimentary to the electric installation, were submitted at a recent public meeting of the inhabitants of Blackpool, held to consider questions relating to electric lighting and traction. The electric installation, it appears, is now doing better, financially, than it did for some years, but the ratepayers are still far from satisfied with the progress it is making. For one thing it is said that the charges are much too high, and that they are not arranged on an equitable basis. "The electric light is the rich man's toy," said one of the leading speakers; "but the poor lodginghouse keepers cannot afford it." The net outcome of the meeting was the adoption of a resolution demanding a more equitable system of charges, and expressing the opinion that no more money should be spent on the extension of the electricity works "until a thorough inquiry has been made by the local government board as to the administration of the electricity department from its inception."

NOTES.—The Kansas City, Missouri, Gas Company has paid into the city treasury the sum of $6,569.57, representing 2 per cent. on its gross receipts for the 6 months ended June 30th last, under the provision of the ordinance regulating the Company's traffic.——The Trustees of the village of Lestershire have denied the petition of the Binghamton (N.Y.) Gas and Electric Company for the right to distribute gas in the place named. The Company declined to pay a bonus for the privilege.——The net gas rate has been reduced by the Northampton (Mass.) Gas Company to $1.50 per 1,000, a concession of 10 cents.——Superintendent Van Auken, of the Cohoes (N. Y.) Gas Company, has been authorized to announce a reduction in the selling rate of 25 cents per 1,000. This puts the price at $1.50. The concession takes effect August 1st.——Mr. H. C. Grittinger has been appointed Manager of the Lebanon (Pa.) Gas Company, vice Mr. George H. Reinoehl, deceased.

Washers and Scrubbers.

[A paper prepared by MR. E. A. HARMAN, of Huddersfield, for the 8th Meeting of the English Institution of Gas Engineers.]

The subject of the paper may be considered as divided between chemistry and engineering. In order to rightly appreciate the functions and duties of washers and scrubbers, it is desirable to review the conditions under which gas is liberated in its distillation from coal.

Coal is the remains of vegetable matter (wood fiber, etc.), composed of carbon, oxygen, hydrogen, nitrogen, etc., which has been submerged in water by land changes time after time. Thus it was covered with mud and detritus flooded down from adjoining lands, and saturated with mineral matter in solution. This is evidenced in the small veins of coal, the interstices of which are filled with finely divided, soluble substances. In coal distillation, therefore, the gases given off do not correspond entirely to those obtained from wood, but consist also of considerable quantities of others. The decomposition by heat liberates sulphur, which at high temperature combines with the hydrogen and carbon given off to produce sulphureted hydrogen and carbon bisulphide. In addition to these, the nitrogen combines with the hydrogen given off to form ammonia, while the carbon and hydrogen chemically combined in the coal are liberated as hydrocarbon gases. The vapors are all condensible, as, indeed, are all the gases under certain conditions; but it is the wide difference in their condensing points which enables the surplus hydrogen, marsh and olefiant gases to pass unarrested through the processes in use for the extraction of impurities.

To appreciate the changes which take place in distillation, an analysis of the gas, after it has deposited a large quantity of its vapors in the hydraulic main, cooling mains, and condensers, will suffice. The composition of the gas at the outlet of the condenser, for the purposes of consideration, may be approximately taken as follows:

	Grains per 100 Cubic Feet.	Per Cent. by Volume.
Tar	—	Some vapors.
Ammonia	220	0.70
Sulphureted hydrogen	950	1.50
Carbon dioxide	1,640	2.00
Carbon monoxide	2,600	5.00
Carbon bisulphide, other sulphur compounds, and cyanogen	70	0.05
Oxygen	—	trace.
Hydrogen	1,850	50.00
Nitrogen	2,000	4.00
Marsh, olefiant and other gases	—	36.75
Total		100.00

The question, therefore, is, which gases require retaining and which eliminating, and the best method available for accomplishing this end.

Hydrogen burns with a non-luminous, but intensely hot flame, and the products of combustion are imperceptible. It is very slightly soluble in water, 100 c.c. dissolving about 2 c.c. of the gas. Hydrogen forms about 11 per cent. of the weight of water and 25 per cent. of the weight of marsh gas. It is, moreover, an essential element in the extensive class of bodies termed acids. Marsh gas, or methane, carbon monoxide, and gaseous hydrocarbons, when burnt, do not have a deleterious effect. Carbon dioxide, nitrogen and ammonia detract seriously from the illuminating power of the gas, inasmuch as they require to be heated to the temperature of the burning gases, and abstract proportionately from the heat of combustion of the others. Sulphureted hydrogen and bisulphide of carbon burn with a pale blue flame, the irritating fumes and vapor therefrom having very injurious effects.

The objectionable gases for removal are carbon dioxide, ammonia, sulphureted hydrogen, and other sulphur compounds. These gases are soluble in water approximately as follows: One volume of water at 60° F. absorbs 700 volumes of ammonia, 3½ volumes of sulphureted hydrogen, and 1 volume of carbonic acid.

It is well known that the solubility of gases decreases rapidly with an increased temperature of the liquid to which they are exposed. Carbon bisulphide is insoluble in water. Ammonia, being a very strongly alkaline body, is capable of neutralizing acids, while carbon dioxide and sulphureted hydrogen are acid bodies. These will, under suitable conditions, combine—that is, the acids with the alkali—to produce salts. Similarly, sulphuric acid absorbs ammonia, as illustrated in a sulphate of ammonia plant, with the exception that whereas sulphuric acid, as a strong acid, possesses great affinity for such powerful alkaline bodies as ammonia, the others, carbonic and sulphuric acids, are only very weak

ones, so much so that they only exhibit acidic properties when in solution, and then but very faintly. Their combinations with ammonia under the most suitable conditions only produce unstable salts, which at ordinary temperatures break up slowly, and at higher temperatures very rapidly, into their constituents. One of these salts—ammonium carbonate—is used in the estimation of the sulphur in the gas in the Referees' test, as it gives off a portion of ammonia at the ordinary temperature to the products of the combustion of the gas. If these bodies could be combined to saturate each other and produce salts, they would be removed from the gas to the extent of the whole of the ammonia and half the volume of carbonic acid or sulphureted hydrogen.

The properties already mentioned suggest at once a means of freeing the gas from impurities—viz., either dissolving out with water, or combining the alkali and acid bodies and producing salts. The readiest means available, taking into account their solubilities, is to wash the gases. From the great solubility of ammonia in water, it might be conceived that its removal would be a most simple matter; but in actual practice it is not so easy as it appears. It only exists in the gases to a very trifling amount when compared with the volume. For the purpose of comparison, we will consider it to be about 7 in 1,000 by volume. One ton of coal, yielding 10,000 cubic feet of gas, therefore contains about 70 cubic feet of ammonia, and would only require theoretically 0.1 cubic foot of water, or about 5 pints, to dissolve it. In actual working, this is far from sufficient. The water is never thoroughly saturated, and, moreover, the solubility takes place directly in proportion to the pressure of the contained gases. If ammonia gas were confined alone in a vessel of 30 inches of mercury, or at ordinary atmospheric pressure, it would be absorbed to the extent of 700 times the volume of water in the vessel; whereas ammonia, existing in the proportion of 0.7 of its volume as a gas, will only exert a pressure of 0.007 of an atmosphere, or 0.21 inch of mercury, at which pressure very little ammonia is dissolved per volume of water, on account of the small partial pressure of the gas, though it is able to retain it when dissolved, because the water is at atmospheric pressure. Therefore, the successful abstraction depends upon the time contact between the gases and the water. It is this which has suggested the desirability of a washer being worked under pressure.

Carbonic acid and sulphureted hydrogen are affected similarly; so that to remove these, if the solubility of them could saturate the water used, a great deal of plunging and agitating of the water would be necessary to effectively remove them. Indeed, it is this object which has been aimed at in purifying machines, concerning which more will be said. Other considerations have also to be taken into account—viz., the instability of ammonia, carbonic and sulphydric salts. Their instability is augmented, as that of the solubility of the ammonia, by the temperature. Whereas at ordinary temperatures the before mentioned solubilities were obtained, a variation of a few degrees interferes seriously with the result, as shown by the following table.

One Volume of Water Absorbs—

Temperature. Deg. F.	Carbon Dioxide.	Loss per Cent.	Sulphureted Hydrogen.	Loss per Cent.	Ammonia.	Loss per Cent.
60	1.002	..	3.23	..	700	..
62	0.973	2.9	3.16	2.1	..	..
64	0.938	6.3	3.03	6.2	..	..
68	0.904	9.7	2.90	10.2	..	..
176	..	..	..	..	200	71

The effect of temperature upon the deposition of ammoniacal salts, particularly in the case of sulphydric and carbonates, is very clearly and decisively shown in the composition of the liquor obtained from the hydraulic main, where the temperatures vary from (say) 140° to 180° F. The hydraulic main liquor contains only about one-sixteenth of the proportion of the sulphides and carbonates deposited in the condenser; while such salts as sulphates, sulphocyanides, etc., are almost wholly left in the hydraulic main liquor. The liquor contains also far less free ammonia than other parts of the washing and scrubbing plants. The fixed ammonia from the hydraulic liquor is approximately 50 per cent. of the total ammonia in it. As the temperature lowers, the sulphides and carbonates of ammonia tend to form very soluble salts, which become dissolved in the aqueous vapor of the condenser, and are found there in the largest quantity. The alkaline and acid bodies contained do not combine to saturate each other to the full limit, since, being only a small proportion of the gas, their pressures are too attenuated. These salts, too, dissociate rapidly at ordinary temperatures. This phenomenon is well known.

Limestone heated in a closed vessel parts with carbon dioxide until the gas liberated exerts a particular pressure. If this gas be pumped off, a further dissociation of limestone occurs, until the further carbon dioxide exerts the pressure at which dissociation ceases. This would continue if the carbon dioxide were pumped off as formed until the limestone was completely decomposed. The inverse would occur by lowering the temperature or by increasing the pressure. Thus it is with the carbonic and sulphydric salts. Their partial pressures in the gas are such as to almost prevent any mutual attraction they might exert, and be dissociated as quickly as formed. Consequently, they do not form, or probably only to a very slight extent. The tendency would be enhanced by washing with alkaline solutions such as gas liquors. It is therefore most important to reduce the temperature of the gas. The escape of ammonia from the scrubbing process during the summer and warmer months is sufficient proof of the dissociating effects of heat, and its influence in effective washing. Sudden cooling is apt to condense out the valuable vapors, and must be avoided.

The quantity of water desirable is a question for careful calculation. Ammoniacal liquor has value as a commercial product, which is dependent upon its strength, and has to be considered. In addition, the washing of the gas by too much agitation with fresh water dissolves and precipitates some of the illuminating constituents. It is consequently desirable to wash the gas with solutions which have previously been partially saturated up to almost saturation point. The quantity of liquor deposited in the hydraulic mains and condensers equals about 50 to 60 per cent. of the total liquor obtainable. This liquor is used for the first washing because it is to some extent saturated with gas, while it is not strong enough to work up profitably in the sulphate plants. The quantity of this liquor is more than sufficient to absorb all the ammonia existing in the gas. The last washing has to be done by clean water, of which about 10 gallons per ton of coal has generally been found sufficient. The reason weak liquor does not effectually remove the whole of the ammonia is because of the before-mentioned dissociability of alkaline sulphides and liquors, the vapors of which are given off appreciably at all temperatures; thus necessitating the application of clean water for the finishing operation.

The best method for washing operations is a matter of great difference of opinion. Water, in order to take ammonia into solution, must be brought into actual contact with it before union can be effected. This contact is made by causing the gas to rub against the surface of the water, and may be accomplished by various methods. It may be brought into contact by allowing it to traverse a column down which is falling a continuous shower of water like rain or spray; or it may pass over a large wetted surface; or it may be agitated in water and forced into small bubbles. It has been pointed out that the effectual removal of the ammonia depends upon the time contact. Suppose water to be distributed down a tower or scrubber, passing 3,000,000 cubic feet of gas per diem, at a rate of one volume of water to every 1,000 cubic feet of gas passed, or nearly 13 gallons—say, approximately, 2 cubic feet—per minute. Consider the water to be divided into drops of ¼-inch diameter, the contents of which equal 0.00818 cubic inch. Then the number of drops represented by this quantity would be 2 cubic feet divided by this amount, which equals 422,494 drops. The surface presented to them would be 576 superficial feet area ($\pi a^2 \times 422{,}494$); and they would be in contact with the gas during the time taken to fall down the tower. This surface area would be increased by dividing the drops finer, as by means of a spray distributor. The mechanical power required to obtain minute distribution is in excess of the relative value of the finely divided spray over a simple system of drops. In dividing the gas into bubbles, a very different case is presented. It is far easier to subdivide the gas into anything chosen than to subdivide water. All that is required is to keep the liquid well agitated, and let the gas issue into it. Washers are based on this well known principle of compelling the gas, in a finely divided form, to pass through a liquid instead of merely over a surface.

In purification, experience has an important part; for, while the laboratory results form an admirable comparative guide, there are forces which come into operation upon the manufacturing scale, when treating millions of cubic feet, that are not apparent when experimenting with a fractional part. It is to the most desirable designs of apparatus for effecting purification that attention and experience are invited.

The washer is one of the earliest forms of apparatus for extracting ammonia and tar. It was frequently used without due regard to its limitations, and so as to materially reduce the illuminating power of the gas; and it was probably this, coupled with the heavy back pressure of some of the old designs, which retarded its extension. Indeed, the back pressure alone was sufficient to discredit any apparatus. It is, or should

be, always used either in connection with a scrubber or a scrubber washer, and always before them. The primary idea of the washer was very good—viz., that of extracting the tar and a large percentage of the ammonia. As stated, the reason the washer does not remove every trace of ammonia is that it cannot be kept charged with clean water, as the gas converts the water into ammoniacal liquor; and the last contact of the gas is therefore with the liquor instead of with clean water.

In 1891, an admirable paper upon the efficiency of washers was published by Dr. Bueb, Chemist to the German Continental Gas Company. He stated that at the Elberfeld Gas Works the separation of ammonia was effected throughout half the works by means of washers.

Temperatures.—Both washing and scrubbing could be effected better if a complete control were obtained of the temperatures of the gas at all portions of the apparatus. It is with this object in view that the condensers abroad are generally placed in closed houses. Where washers are erected in the open air, the liquor therein frequently falls below 60° F., with serious reduction of the heavy hydrocarbons. It is therefore desirable to have the washing apparatus inclosed.

Tar Extraction.—In the United Kingdom the common practice is to extract whatever tar is left in the gas after condensation at the washers and scrubbers, which has, however, the objectionable point of rendering these portions of the purifying plant less efficient for their particular work. Upon the Continent preference is given to the extraction of tar by means of tar extractors, such as those of MM. Pelouze and Auduoin. It is true that this has been adopted in some few works at home, as well as other systems of tar extraction. The separate operation for mechanically extracting the precipitated tar or floating particles is a debatable question. The object of many gas engineers is to condense out the the tar, which, of course, necessitates large condensers—certainly larger than would be required if the tar were previously extracted. Even with large condensers it is impossible to condense out all the tar at atmospheric temperatures. Many engineers prefer the gas remaining in contact with the tar as long as possible. It is questionable whether it is desirable to bring down the temperature of gas to 60° before washing; the object of doing so being principally to reduce the quantity of tar in the gas.

Scrubbers.—The form of tower scrubber most familiar is, perhaps, the Mann and Walker type. It consists of a cylindrical tower, the height being about three to five diameters. A machinery room adds finish and ornament to the top. In the upper portion of the vessel is a brushwood wheel, which receives a supply of clean water from revolving water distributors, ingeniously designed to work eccentrically, so that in traversing the outer circumference of the vessel they move slowly; but when nearing the center, rapidly. The gearing is worked by bevel wheels from a vertical shaft, supported from the sides of the vessel. The contained material generally is either coke or boards on edge, although other material is also used. The channelling of the gas and water through coke makes boards preferable. The material is supported on a series of cast iron grids, leaving each tier distinct and separate for the dispersion and diffusion of the gas. The gas enters at the base, meeting the strongest and warmest liquid, and passes from tier to tier vertically to the top of the vessel, where it descends an outlet pipe placed in the center. The water, entering at the top in the form of finely divided spray, descends through the material, and the gas being forced through the separate tiers gets well brought into contact with the moisture and sharp edges. Mr. William Mann, formerly Engineer to the City of London Gas Company, and Mr. William T. Walker, with whom the author had several conversations upon the subject, strongly recommended the gas always to be passed through the scrubber under pressure, instead of exhausted. The gas yields its ammonia to the water; the tar is mechanically arrested by the coke, and drains to the bottom of the vessel, the base of which is generally designed to permit the tar and liquor draining to the outlet pipe leading to the store well. Where a series of tower scrubbers are used, weak ammoniacal liquor is pumped into all except the last or finishing one, in which clean water is employed. The ammoniacal liquor when treated in this manner becomes a valuable purifying agent, and is also itself much enhanced in value. One advantage of using liquor is that the hydrocarbons are not deposited as when water only is employed. When scrubbers are used in the dry state—that is, without a liquor or water supply of any kind—the material necessarily extracts or retains the tar only.

Tower scrubbers require cleaning out about once in every eight to ten years. They may be partially cleaned at intervals by steaming; always taking care to commence the steaming process at the top, and following down tier after tier, so as to allow the condensed water and liberated tar to drain downwards, leaving the upper tiers cleaned. As regards the most desirable material for use in scrubbers, Mr. George Livesey (to whom belongs the credit of introducing boards) gives the following relative area of wetted surfaces:

Coke.....	8½	square feet per cubic foot.
Drain pipes 2 inches diameter	21	" "
" 3 " "	17	" "
Boards.....	31	" "

It will be seen that, apart from other desirable recommendations, boards present between three and four times the area of coke material.

In a tower scrubber filled with grids of ⅝-inch by 9-inch boards, with ⅝ inch distance pieces, a very large surface is exposed for wetting, and consequent frictional surface action on the gas. In a tower designed for passing 3,000,000 cubic feet of gas per day of 24 hours—say, 15 feet in diameter and 60 feet high—having six tiers of grids, the surface equals 268,000 square feet. These grids occupy 40 per cent. of the cubic capacity of the tower. In the tower there is approximately 10,602 cubic feet, less 4,356 cubic feet filled with material; leaving in the interstices some 6,246 cubic feet. The inside of the scrubber, together with the surface area of the grids, presents 270,820 square feet. The gas passes at 34 feet per second, and will be in the interstices of the material such a time as it takes to fill up the 6,246 cubic feet divided by 34, which equals nearly three minutes. Multiplying the surface—268,000 square feet—by the time, and 804,000 square feet are obtained, which is the value of contact with the gas passing. The result may be written $\frac{\text{total surface}}{\text{volume of gas}}$, which expresses the amount of contact surface available for each volume of gas. The capacity of any washing machine may be gauged from this rule, independent of design. Again, gas, as has been referred to, may readily be reduced to bubbles of very small diameter, and by this means the contact surface can be obtained equal to any other. Suppose the gas is divided into bubbles of ¼ inch diameter, then for each cubic foot of gas we obtain about 288 square feet of surface area. As gas rises through one foot of liquor in about one second, for this to equal the capacity of the tower scrubber described it would have to pass through a column of liquid 27 feet deep. The expenditure of power to effect this would be very much in excess of the force required to deliver 13 gallons of water to the top of the tower.

The late Mr. Wyatt recommended 100 cubic feet of internal capacity of the vessels, with a gas contact of from 15 to 27 minutes for maximum and average makes; and he stated that 12½ to 15 per cent. of this volume could be utilized by introducing a washer into the base of the scrubber. The volume of gas contained in the scrubbers at one time amounts to about 1 per cent. of the maximum make per diem. The horizontal net area of all the scrubbers recommended by Mr. Wyatt is equal to 2 superficial feet per ton per diem on the maximum make. The late Dr. Hurter's paper on "Coke Towers" and similar apparatus, in 1893, is a valuable contribution to the subject.

Water Distributors.—It is difficult to insure thorough distribution over the whole area of a large scrubber, though accomplished at the first tier; the liquid collects and drains in channels through the remainder. The author has tried jets of steam in each tier, with good effect as to saturating the material all over; but the increased temperature of the gas prohibits its use. The Barker's mill arrangement is perhaps one of the best forms. Gurney's jet consists of a sliding tube with a nozzle, having a fine hole 1-64th of an inch in diameter. The liquid is forced through this at considerable pressure, causing it to impinge against a circular glass disk. Green's water distributor, Goldsmith's, and many others might be cited.

Washers.—Washers are of numerous designs. The gas passes through a series of perforated plates, brushes, bundles of grids, and many other devices placed in chambers and constantly wetted. The surface of these, and the contact, are enormously increased in many cases by constant revolution, and possess advantages, inasmuch as the liquor is retained without pumping, being gradually run off as the strength increases. The gas leaves behind the larger portion of its ammonia in the chamber. The liquor, being retained, is consequently worked up to a far higher degree of saturation. An analysis of the liquor from one of these washers shows clearly the action of the gas. In the first chamber, a little of the fixed ammonia is obtained; while the free ammonia, or that held in solution with such weak acids as carbon dioxide, will seem to have displaced the sulphureted hydrogen, it being found there in the proportion of 70 per cent., compared with the sulphureted hydrogen similarly held. In the latter chambers the sulphureted hydrogen seems to enter more into solution. In the last chamber it is side by side with the carbon dioxide, and is found up to 50 per cent. The acid equivalents throughout the series get gradually less. The proportion of carbonic acid and sulphureted hydrogen in the

liquor, and the proportion they bear in relation to each other, vary, principally owing to the strength of the liquor, and partly under the circumstances of formation. Generally between 50 to 70 equivalents of alkaline ammonia are combined with 50 to 70 equivalents of the acids, carbon dioxide and sulphureted hydrogen, the sulphureted hydrogen of which forms nearly 20 per cent. The strong liquors contain less than the weaker ones. The operations of washing remove 2 or 3 grains of carbon bisulphide per 100 cubic feet; and the illuminating power is slightly diminished.

It has been shown why the alkaline and acid bodies do not combine to eradicate themselves, on account of their non-affinity at the partial pressures in which they exist in the gas. It has also been shown why the water, compared with the solubility, is insufficient to eliminate the ammonia. When the pressure becomes more attenuated, the forces between the dissociability of the weak solution more nearly approximate equilibrium—a rise in temperature effecting the liberation of a small quantity, or a corresponding lowering effecting the absorption. The relative capacities of washing the gas by rain vapor, material spread, surface contact, breaking the gas into bubbles, and the presentation of new surface area to the action of the gas in the various forms of mechanically worked washers, have been dealt with. Rain vapor is of little practical use, the mechanical force necessary to present it in this form being far from the advantage derived from washing the gas by breaking it into bubbles. The mechanical force necessary to break the gas into bubbles, simple as it appears, is greater, while the surface thus obtained is less, than is required for passing the gas through tower vessels with large surface area. Even these are behind mechanical washers of various kinds, as their surface contact can be regulated; and it is also enhanced by utilizing strong liquors for the crude gases. While considering surface contact, it may be mentioned that a limit may be obtained in the fineness of the layers presented to the surface, inasmuch as the material required to do this occupies a greater portion of the cubic area of the tower or machine; thus accelerating the flow of the gas, and not allowing the time contact necessary for the absorption of the constituents it is desired to extract.

The "Livesey" Washer.—The washer designed by Mr. George Livesey consists of a rectangular cast iron box, the upper part being formed into an inlet chamber, together with one or two outlets. To the lower flanges of these inlet chambers are fastened a series of wrought iron tubes, having holes 1-16th of an inch in diameter. The interior of these tubes is in communication at the ends with the outlet chambers, while the spaces between them at the ends are securely closed up. The gas has free access from the inlet chamber direct to these intermediate spaces, passing down them and depressing the liquor until the gas escapes through the inclined portion of the perforated plate to the first space, which is filled with liquor, through which it bubbles until it comes in contact with the horizontal part of the perforated plate, carrying some of the liquor with it to the upper surface of the plate. The bubbles of gas pass through this liquor into the tube space, and convert the surface into light foam, which flows along with the gas into the outer chambers. The liquor drains from the washer by means of overflow pipes, by which the level can be adjusted as required. The inlet for the liquor supply is placed at the lower part of the washer. Glass windows are fixed in the sides at opposite ends of the tubes, so that the bubbling and washing of the gas in the tubes may be clearly observed. Special provision is made in the lowest part of the chamber for the collection of the tar, which is separated, and falls to the bottom, being drawn off from that level, independently of the liquor, at regular periods. The apparatus possesses the great advantage of being absolutely automatic, and requiring only a trifling amount of attention; while, for its compactness and the small space occupied, it is probably the most economical and efficient type in existence. By the minute subdivision of the gas, which is brought twice into contact with the liquor, the entire removal of all the tar and the greater part of the ammonia is insured. In some works the ammoniacal liquor from the tower scrubbers flows by gravitation, *viâ* a tar and liquor separator, direct into the washer, which is fixed at a desirable level for the purpose. The number of perforations through which the gas has to pass per foot of trough is 3,264; thus dividing the gas into many thousands of streams. Where more than one of these washers is used, they are placed at different levels, to admit of the liquor gravitating from the last one to the first. The extensive adoption of this washer is sufficient guarantee of its efficiency.

The "Charles Hunt" Washer.—The "Charles Hunt" patent washer is, in reality, a combined washer and scrubber. It is perfectly automatic. It consists of a series of chambers placed one over the other. The gas enters at the base and issues through vertical tubes, over which are placed inverted troughs sealing each compartment in liquor. Water is admitted at the top, and descends from tier to tier to the bottom, so that the gas on entering meets with warm liquor, and in its ascent is subjected to cooler liquor, until at the outlet in the last chamber it meets clean water. This gradual cooling of the gas is in accordance with the consensus of opinion as being the best preventative for naphthaline stoppages. This washer possesses the advantage of being readily adjusted for variable makes of gas. A series of test cocks are provided for ascertaining the actual duty performed in each chamber. In the lower tiers, when desired, weak ammoniacal liquor from the hydraulic main and condensers can be admitted. One of the chief features is the enormous area of washing surface presented to the gas. The small ground area required by the apparatus is a great advantage, especially where the site is limited. The adjustment of the depth of seal in each chamber can be made in a few moments while working. It is a most efficient apparatus.

Marshall's Scrubber and Condenser—Mr. Marshall, of the Copenhagen works of the Danish Gas Company, has designed an effective combined condenser and scrubber. The gas passes in a downward direction between tubes, through which water is pumped in an upward one. The warm gas thus meets at the inlet with a moderately warm condensing surface, and is gradually cooled in its passage through the apparatus. Water is dripped over the exterior of the water tubes, and the condenser becomes an effective scrubber, as the tubes present a considerable area of wetted surface; while a secondary effect of the trickling water is to clean the tubes from any deposit of tar, etc. The water is prevented from running down the sides of the condenser by a series of drain plates. One battery of seven sections is capable of condensing 350,000 cubic feet of gas per 24 hours from 142° to 63° F.; the temperature of the inlet water being 60° F. The consumption of water to effect this result averages 5,000 gallons. The battery contains 1,054 square feet of water surface, and 204 square feet of air surface. The apparatus is automatic, and does not require machinery other than for water purposes.

Anderson's Washer.—Mr. Anderson has always strongly advocated the use of washers. His design is composed of a chamber containing a number of trays, underneath which a series of serrated bars extend from side to side. Weak liquor is admitted at the top. The trays seal in liquor, and the gas issues through them minutely divided.

Young's Washer.—The washer designed by the late Mr. Hugh Young, the Engineer of the extinct Birmingham and Staffordshire Gas Company, consisted simply of high, cast iron, rectangular vessels filled with wooden boards, through which the gas traverses up and down in two or more sections; being thoroughly drenched with liquor, a continuous supply of which descends from the top.

Reid's Washer.—Mr. John Reid's rotary washer, made for the Edinburgh and Leith Gas Commissioners, consists of two hollow cylinders, all around which are fixed buckets, giving the appearance of a large water wheel. The wheels, revolving in a tank of liquor, discharge their contents inside the cylinders, which are revolved by a rack, fixed on their circumference, actuated by a pinion.

The "Holmes" Washer.—Messrs. W. C. Holmes & Co.'s patent scrubber-washer is in successful use in many gas works. It is of the horizontal rotary form. The washing substance therein consists of a series of brushes made from a weed which has grown in water; thus ensuring a minimum amount of decomposition from the liquid contact. Such brushes contain an enormous quantity of wetted impinging surface for the small space occupied. This scrubber washer, in addition to being one of the most efficient for removing ammonia, is also being used with considerable success in connection with cyanogen plants.

Kirkham's Washer-Scrubber.—This "Standard" washer scrubber is of the horizontal rotary type. The purifying action consists in the gas passing at all points over a wetted surface composed of constantly revolving wood grids. These grids are arranged in a series of horizontal compartments, the division plates forming them permitting the water to overflow from one compartment to another. The gas, in passing through in this manner, comes in contact last of all, at the outlet, with clean water. The "internal bundles" were formerly made of perforated plates; but in order to reduce the weight for the driving, etc., wood has been substituted. It is one of the most popular forms of washer-scrubber in existence.

Whimster's Washer and Exhauster.—Mr. Thomas Whimster's combined exhauster and washer, made by Messrs. Hanna, Donald & Wilson, possesses several features of interest. A horizontal cylinder is divided into three compartments. Between these partitions there are a pair of revolving discs connected by a number of curved blades, thus constituting a series of bucketlike chambers. The gas entering the central division is carried down by the curved blades below the liquor level, and

escapes through openings at the center of the revolving drum, and up through the liquor into two side divisions provided with outlets. The principle of thus exhausting the gas during the washing operation is worthy of further development and adaptation.

Laycock and Clapham's Washer.—This is of the rotary horizontal type, consisting of compartments in which cylinders, fastened on a central shaft and filled with wood balls, revolve in ammoniacal liquor; thus insuring the complete passage of the gas through, and in contact with, a large area of fresh and continuously wetted material.

The "Cathels" Washer.—The washer by Mr. E. S. Cathels is composed of a series of small washers, each of which is complete. They are elevated one above the other successively, and have also been placed one over the other vertically.

Walker's Purifying Machine.—Messrs. C. & W. Walker's machine consists of a rectangular vessel containing in its lower part a washing chamber, having on each vertical side numerous horizontal troughs, open at the bottom, which have fine perforated slits on each side. The washing chamber is filled with liquor to the level of these perforations. The gas entering the receiver fills the troughs, from which it displaces a quantity of ammoniacal liquor, and goes through the immersed perforations. It then passes through the stronger liquor outside, and is thus relieved of its tarry particles, which fall through the liquor into the bottom chamber, and are subsequently drawn off. The gas, after leaving the washing chamber, ascends through rectangular openings, over which are fixed the boxes of devices containing wetted boards. These devices are fixed upon vertical shafts in connection with gearing for moving them up and down in the liquid. The gas travels from chamber to chamber between the wetted boards in each tier, until it arrives at the top free from ammonia and tar, and a portion of the carbonic acid and sulphureted hydrogen. The devices constantly dipping into the liquor expose to the gas a large amount of wetted surface. The number of dips per minute adopted at Huddersfield is about six, and this in a 3,000,000 cubic feet machine equals about 10,000,000 square feet per hour exposed to the gas; so that no portion of it can remain unwetted for more than one-sixth of a minute at a time. The action of this enormous wetted surface is to absorb the ammonia from the gas, thus forming strong ammoniacal liquor, which descends into the bottom washing chambers for the purpose of taking up the carbon dioxide. Clean water is admitted into the top at the rate of about 10 gallons per ton of coal carbonized; and this water descends from chamber to chamber. Weak liquor is admitted into the bottom tiers. The liquor overflowing into the next lower tier of the machine meets the ascending streams of the gas nearly wholly free from ammonia. Only about an inch of back pressure is thrown by this machine, which is really a most efficient one. The power required for driving it is so small that a man can work the whole of the machine by taking hold of the flywheel and pulling it round with one hand.

Many different forms of washers and scrubbers have ingenious and interesting points with which the members are familiar, such as the following: The "Saville;" the "Coffey" still, which is sometimes used for a scrubber and washer; Mr. Paddon's excellent washer-scrubber; Mr. George Lowe's scrubber; Mr. Warner's scrubber; Mr. Cleland's steam scrubber; Mr. Anderson's brush scrubber; Messrs Cockey & Sons', and many others. The examples described will probably be sufficient illustrations, as representative of the various designs in use.

Ammonia.—Almost invariably upon gas works, all the ammoniacal liquors, whether from the hydraulic mains, condensers, cooling mains, washers, scrubbers, etc., are drained into one common storage tank, though, having regard to the various compositions of these liquors, this is hardly a scientific way of dealing with them.

The question of the desirability of using purified liquor is too extensive for present consideration. In Hills's process, the ammoniacal liquor is passed through a kind of still, so regulated that about 50 per cent. of the sulphureted hydrogen and carbon dioxide present is liberated. The purified liquor, as it is termed, is then run back into washers, and is ready to take up another quantity of these impurities. Ammoniacal liquor used in washers, unless purified by some such process as this, must not be allowed to be too heavily charged with carbon dioxide, or it will displace the sulphureted hydrogen in a similar manner to that which obtains in the ordinary purifiers. The general principle is to heat ammoniacal liquor to a temperature of about 200° F., when the greater part of the carbon dioxide and sulphureted hydrogen is driven off; the bulk of the ammonia being retained.

Comparatively little attention is paid to the properties of ammonia at various temperatures. Coals contain from 1 to 2 per cent. of nitrogen, and hold about 14 per cent. of this amount as ammonia during distillation at ordinary temperatures. This represents 5.7 pounds of ammonia per ton of coal. Thus:

$$2{,}240 \times 1.5 \text{ per cent.} = 33.6 \text{ pounds} \times 14 = 4.7 \text{ pounds N.}$$

$NH_3 = 17$, molecular weight. $N = 14$.

$$\frac{4.7 \times 17}{14} = 5.7 \text{ pounds of ammonia per ton.}$$

The weight of a cubic foot of ammonia is 316.77 grains.

Cannel coals generally contain less nitrogen than common coals. It is generally considered that Continental coals produce much less fixed ammonia than those in the United Kingdom. The nitrogen in coal may be reckoned as distributed thus:

As ammonia	14.50 per cent.
As cyanogen	1.56 "
Free in gas, and combined in tar	35.26 "
Coke	48.68 "
	100.00

Mr. Lewis Thompson recommended that a small percentage of ammonia should be left in the gas, to combine with the sulphur compounds and produce sulphate of ammonia, as being likely to have a sanitary influence. Owing to the reduction of sulphur compounds, and the increased purity of the gas now issued from gas works, it is undesirable in every way.

Conclusion.—Failing a continuous process of purification in closed vessels, it is most desirable to get as large a percentage of purification as possible done in the existing closed vessels, such as have been enumerated. A good deal more could be effected by liquid purification than is generally accomplished; and this principle was generally recognized in the early days of gas purification. It will be remembered that some 40 or 50 years since a solution of sulphuric acid was used for purification; but the "acid boxes" have become extinct, on account of the affinity of sulphuric acid for the hydrocarbons. It is probable that a return, in some improved form, will be made sooner or later.

The author realizes that the foregoing remarks are but a trifling contribution to a most important subject.

Electric Utilization of Water Powers.

In a paper on the topic named in the heading (read by Mr. L. D. W. Magie, at the Quebec meeting of the Canadian Electrical Association) the author said:

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season.

Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmitted by the direct current system has been up to 12 miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over 2 miles, and even the advisability of this is looked upon to-day doubtfully.

The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100-horse power for both 1 and 10 miles, the loss in transmission to be 8 per cent. and the voltage to be 500 volts.

For each leg of a 1-mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each 1 mile long, weighing 15,312 pounds, which, at 15 cents per pound, would cost $2,300. For each leg of the 10 mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each 10 miles long, weighing 1,531,200 pounds,

which, at 15 cents per pound, would cost $230,000; or the power would cost, at 10 per cent. interest and depreciation on copper alone, $2.30 per horse power per annum in the first instance, and $2.30 per horse power per annum in the second case.

If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100-horse power for 10 miles, the condition would be entirely different, for instead of forty No. 0000 wires, each 10 miles long, there would be required for each leg but one No. 4 or two No. 4 wires each 10 miles long, weighing 15,300 pounds, which at 15 cents per pound would cost $2,300, or the same as transmitting the same amount of energy only 1 mile at 500 volts.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor. The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses, and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of horse power actually sold, will be the actual cost per horse power for the case in question.

Probably the greatest competitor to electric power is steam power. In a few instances power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded.

The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per horse power may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided, again, a sufficient market can be obtained for power.

When electrically transmitted power does not cost more than $100 to $140 per horse power installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., has to be secured. When land is cheap these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one.

The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall, and whether it is dependent on natural conditions or requires the building of large dams. Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached. When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable a number of these wheels must be coupled together in order to get the required power.

The speed required can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency. With higher heads a larger amount of power can be obtained from fewer and smaller wheels, with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible. A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300-k.w. generator to run at a speed of, say, 75 to 100 revolutions per minute, when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5,000.

The next item of considerable expense is the transmission line. The poles, with their appurtenances, exclusive of wire, will cost between $250 and $500 per mile, varying according to circumstances. Rights of way for the placing of poles may often be expensive. The transmission wire must be considered separately.

Anxious Moments in a Gas Manager's Day.

By an "Old One," in *Gas World*.

So far we have been concerned mostly with the operations inside the four walls of the gas works. The tendency of the times seems to be towards making the gas manager much more of a public man than he used to be. When the responsibility as to supply was generally accepted as ending at the consumer's meter, and things went on from one year's end to another at the same rate, with no special increase of business to provide for, the manager was almost a stranger on the outside of the entrance gates to the works. But now he is called upon to keep in intimate touch with the consumers, to superintend trials of street lighting on the latest known systems, to supply stoves and apparatus on hire and to be responsible for the efficient action of the same, while variations in the demand, usually in the right direction, necessitate continual additions and enlargements to mains. In many instances, also, the gas company has undertaken the supply of gas appliances of every description. So that instead of spending the greater portion of his working hours at the works, superintending personally the details of the daily operations, the manager is obliged to delegate the routine duties to a responsible works foreman. Under the old plan the manager personally attended to the filling and emptying of purifiers, the adjustment of the supply pressure, and such like duties; but under modern conditions he is not to be found at the works for more than two or three hours daily. Thirty years ago or more, the usual qualification was "good carbonizer acquainted with the routine of a gas works," but a great deal more is now required. The young man who hopes in due time to obtain a position as manager of a provisional gas undertaking will do well to bear these points in mind, and to carefully consider the position he will be called upon to occupy in the district as well as in the gas works. A series of papers on "Anxious Moments" would not, therefore, be complete without a few remarks on these later developments of and additions to the duties of a gas manager.

Storage.—The extreme lightness of gas is in many respects an advantage, but it adds greatly to the cost of storage and distribution. The fact that 2 or 3 shillings' worth of gas occupies the area of an ordinary apartment necessitates very large vessels for storing it. The cost of the storage and distributing plant represents, approximately, one-third of the whole capital, and means a charge of 5d. or 6d. on each 1,000 cubic feet of gas sold. We frequently hear of the storage of gas in contrast with electricity, which cannot be so stored. Although this is a very great advantage, still the storage of gas is of a limited character, more resembling the accumulators in connection with hydraulic power apparatus than a barn or warehouse in which several months' supplies can be laid by. The gasholders will provide for fluctuations during day and night, or for those due to changes of climate, but the rate of production must closely follow the rate of consumption. The gas engineer cannot, as most manufacturers do, make up several months' stock when trade is slack, or materials are cheap. An ideal state of things as regards storage is such as would be practicable with small valuable goods, like watches or jewelry. Suppose a manufacturer doing a regular trade in watches of about 250 per annum, the demand varying regularly from a minimum of 10 per month at midsummer to a maximum of 30 per month at Christmas, he would put down a plant and employ a staff equal to a turnout of 20 per month. The gas engineer cannot approach such a state of things. He must have a plant equal to the maximum demand, a large proportion of which must therefore remain idle, or insufficiently occupied, during the greater part of the year. Under the ordinary circumstances of gas supply by the retort system of production, the fountain-head of the distribution plant must consist of not less than two gasholders, representing an aggregate capacity equal at least to 24 hours' maximum demand. Water gas plant, as is well known, can be put into operation in a few hours, and admits of considerable variation in production, and therefore a smaller storage capacity is sufficient where that system is in use.

Governing.—The difficulties surrounding the maintenance of any required degree of pressure under varying rates of consumption are now things of the past, and a governor that is perfectly reliable in action and independent of inlet pressure is now obtainable at a very moderate price. The water system of loading, enabling the adjustment of the pressure to be extended over half an hour, or even over two or three hours, has replaced the weights; so that the troubles due to the vagaries

of the governors, or of the man who "put on" or "took off" the pressure, belong to a closed chapter of history, and therefore do not call for any extended notice. I could fill many columns with stories about governors that would start "jumping" if the holder valves were changed, or sometimes for no appreciable reason at all; or of troubles due to carelessness in putting on the weights when reducing pressure. The modern governor appears to follow scientific principles and to be controlled by them, but the old type bell-and-cone apparatus maintained a glorious independence, and acted upon laws, or vagaries, peculiar to itself. In addition to variations due to inlet pressure they did not follow the rate of consumption; so it was usual to look at the pressure gauges at intervals during the evening, and adjust them accordingly. Several weeks' experience were necessary to understand the idiosyncracies of the apparatus, and even with that there were occasional eccentricities that could not be accounted for.

One of the holders should be large enough to deal with the variations of make and consumption between 6 P.M. and 6 A.M. next morning, thus avoiding the necessity of changing the holder valves during the night, when the foreman or manager is absent. It is well to keep the holder valves directly in charge of one man; and, in any case, the smaller the number of persons authorized to operate them the better. Speaking of holder valves reminds me of a safety governor, lately introduced, which is placed on a branch pipe leading from the outlet of the station meter to the inlet to the governors. If the gasholder outlets are all closed, or one is by inadvertence closed before opening another, the safety governor comes into operation, and prevents the district being placed in darkness.

Pressure in the District.—The distributing plant, comprising mains, services and meters, requires continuous and systematic supervision. The mains, having been once properly designed and laid, are practically indestructible, and the only reason for renewing them is because the increased requirements demand a larger size of pipe. But the services and meters should be renewed periodically, a reasonable proportion being dealt with every year. The manager must be in close touch with the conditions of pressure, etc., that prevail in all parts of the district. The conditions of pressure in the governor house do not necessarily represent those at the consumer's burner. The pressure at any one particular part of the district will depend upon several different factors, apart from the pressure at the outlet from the works. First, there is the effect of altitude, which means, roughly, an increase of one-tenth inch pressure for every 10 feet rise, and, conversely, a loss of one-tenth inch for each 10 feet fall. Secondly, there is the rate of consumption at the moment, not only on any particular premises, but in other parts of the district. In a town where all the shops close at 8 o'clock, or where there are mills or factories that close at a regular hour, thus leading to a sudden increase or decrease in the rate of consumption, it is a well-known fact that the pressure increases all over the district immediately after closing time. These and several other points that the manager should know can only be ascertained by careful observation at the houses of the consumers. At least once in every year a careful series of testings should be made all over the district. It is only by the aid of a complete knowledge of the district that a satisfactory reply can be furnished to the consumer who wants to know why he cannot get a good light at 7 P.M., when he can have more than he wants at 11 P.M. Then, thirdly, the meter is a machine that is worked by the gas, just as a steam engine is worked by steam, and a certain proportion of the pressure must go to work it. The balance that remains after overcoming these and a few other obstacles is the actual pressure that causes the gas to issue from the burner.

We talk, in common parlance, about the day pressure being one-half the night pressure, overlooking the fact that this expression represents the condition of things in the governor room only, and that the day consumption, consisting mostly of gas used for heating and cooking, requires more pressure at the burners than the night consumption does. In the evening the rate of consumption becomes so rapid that there is a large loss of pressure during the passage from the governor room to the consumer's burner. We increase the initial pressure at dusk, say, from 15 to 30-tenths, but the average pressure on the various burners throughout the district may actually decrease instead of increase. Suppose we call the initial pressure a, the loss in transit b, and the consumer's burner pressure c. Then $a = b + c$. But looking at the fact that b is liable to wide variations, the chief factor in which is the rate of consumption as related to the sizes of the pipes to be traversed, it follows that, a being constant, c is liable to variations in an inverse ratio. The alterations in pressure that are made at the works from time to time during the 24 hours are simply an attempt to keep track of the variations of b, and in order to do so in anything more than a very rough and ready style, we must have a fairly intimate knowledge of the nature and extent of these variations. In these days of atmospheric burners, both for heating and lighting, c should not be less than 12-tenths inch at any hour of the 24.

Hiring Out.—Another point that is gradually forcing itself upon the attention of gas companies is that although an ironmonger or a gasfitter is very willing to supply a stove or any other gas appliance, and possibly to fix the same ready for use free of charge, he does not take much trouble to instruct the consumer as to the proper way of working it, or as to the maintenance or renewal of parts liable to rapid wear. In many cases incandescent burners have been rejected simply because they required blowing out. The questions of careful instruction and of maintenance are largely concerned in the success of the hiring out system. The consumer hires a stove, not necessarily because he prefers that system, but because the gas company keeps it in working order, and because directly any little trouble or defect arises he can send to the gas office and have it put right. This modern addition to the gas manager's responsibilities will increase and extend till it becomes a very large order. It commenced with the cooking stove, but it will extend to appliances of all kinds, and especially to incandescent lighting burners. And as the ultimate destination of the gas has now been reached, I conclude this series of articles. There may be "anxious moments" afterwards with a gas consumer who thinks his bill is too big and so forth, but a consideration of these does not come within the scope of the writer's present instructions.

Some German and French Experiments Regarding the Ignition of Gas in Coal Mines by Electrical Apparatus.

Mines and Minerals reports that during the fall of 1897 the most extensive series of experiments on record was carried on in the testing gallery of the Consolidation colliery, near Gelsenkirchen, upon the dangers arising from the use of electrical appliances under the conditions actually used in mines. They were conducted conjointly by representatives of the Westphalian miners and by the Siemens & Halske Co., of Berlin, who furnished the apparatus, and the abstract of the report, which appeared in the January number of *Glück Auf* and the *Elektro Technische Zeitschrift*, shows that the results were not unfavorable to the use of electrical apparatus.

The testing gallery was elliptical in section, 4½ feet wide, 6 feet high, 110 feet long, closed at one end and open at the other, and covered with three thicknesses of pitch pine held in place by I beams. Safety holes covered with stout paper were in the top, and one side had 15 strong glass windows. The explosive chamber at the end of this passageway which was used for these experiments had a capacity of 350 cubic feet. The firedamp used was brought from an abandoned mine through a pipe entering into this explosive chamber. This gas contained 38 per cent. of CH_4, and by means of a meter the percentage of gas used could be regulated from 6 per cent. up to 9½. Fine coal dust was also used. The following results were obtained:

Incandescent Lamps.—Naked filaments raised to high incandescence may or may not cause explosions and may remain intact and burn after explosion; in most cases ignition seemed to follow the breakage or burning of the filament and the accompanying sparking. Lamps with their bulbs attached were shattered, the bulbs and filaments breaking simultaneously and producing bad sparking, and sometimes an explosion, and sometimes not. In other cases the filaments remained intact when the bulbs were smashed, and here again explosions may or may not follow. Not merely the mechanical strength or the watts must be considered, but the amperes seem to be the chief thing. Currents of not less than 0.6 ampere, continuous or alternating, did not produce ignition, but often sparking; stronger currents generally did give ignition.

The conclusions as to lamps are:

Use stout globes with round bulbs, to prevent cracking from water dripping on the hot bulbs; and, for further production, cages. Take low current lamps (0.6 ampere maximum) and high voltage, but not above 150 volts; all excessive volts are dangerous. Have short leading-in wires, far apart lest they be bent together and make short circuit. Avoid, for the same reason, lamps with two filaments in series. This summing up is against the common portable lamp which has the further disadvantage of not indicating the presence of firedamp. Otherwise, electric incandescent lamps are recommended as affording probably the safest underground illumination. Not much was done with arc lamps, but they do not appear to ignite coal dust, even in an atmosphere of 4 per cent. of marsh gas; but in 6 per cent. explosions took place, whether the lamp was already burning or was switched in.

It is noteworthy that a dust storm did not make the arc flare up, but arc lamps, continuous and alternating alike, must be condemned in fiery mines, although it must be noted that arc lamps have been used with impunity in rubber works, where the air is saturated with benzine vapor.

As regards switches for one or more lamps, current strength, and still more so voltage and self induction in the circuit, play a great part, and while in general slow switching in is more dangerous, on account of arcs forming, for circuits with high self induction, continuous or alternating, rapid motion of the switch is to be avoided. In some cases the switch was thrown 30 times before ignition occurred. Carbon points may be glowing without causing explosion, as long as there is no arc. Spark extinguishers which form a momentary arc to be condemned. Hot wire resistances seem in themselves harmless, but danger threatens from contact. A set of resistances was placed horizontally, and one hot spiral touched another, when explosion immediately followed. Glowing wires did not cause explosions, even when the explosive atmosphere was driven through them by means of a fan, but in this case the hot wire would have no time to decompose the gas. Melting wires, especially copper, may ignite the gas; but an iron wire buried in coal dust and heated by the current until it arced strongly, did not ignite the dust, either when it was quiet or when it was stirred into a cloud. Fusing wires protected by a shunt may be considered harmless; but ordinary safety fuses of lead and tin behaved badly, as would be expected.

Electric Motors.—Larger sizes are safer than smaller types, because variations in the load affect them less. Carbon brushes are least likely to do harm, because they spark so little. A motor placed in a box under a fine wire gauze cover set fire to the explosive mixture in the box on starting, but the flame did not strike through the gauze. Experiments with 5-horse power tri-phase motors were quite satisfactory; a brush was 30 times lifted off one of the contact rings of such a motor without any mischief resulting, though there might have been explosions with very abrupt changes in the load, and to avoid danger the motor should be encased and double brushes used.

The report says: "It is only necessary to apply the ordinary precautions with electricity, and it was their disregard which brought electricity into bad repute in the early days." Continuous current electric motors and switches, fuses, etc., should be avoided in dangerous parts, and they should be encased wherever they are put up. It is well to err on the safe side. Many sparks do not produce explosion; but no rule can be laid down as to what is safe and what not.

Messrs. H. Couriot and J. Meunier have also carried on a series of experiments similar to the above and they find that there are three classes of electrical phenomena capable of exerting influence on explosive mixtures, viz.:

1. Incandescence of the conducting wire.
2. Electrical sparks, particularly those due to a broken current.
3. The voltaic arc between two carbon terminals.

They summarize the external influences of electricity on firedamp mixtures as follows:

1. Electricity gives rise to but one single apparent phenomenon in the explosive firedamp mixture, namely, explosions.

2. Incandescent metallic wires are incapable of exploding the most explosive of such mixtures.

These two rules have been proven by several hundred experiments under various conditions, no explosion occurring so long as the incandescent wire remained unbroken.

3. Explosion, when occurring, is caused solely by the spark produced by the breaking of the incandescent conductor, the explosion, being due to the interruption spark alone, cannot be produced by the small sparks which occasionally pass between the incandescent wire and the metallic conductors supporting the same. It is not necessary that the broken wire be previously raised to incandescence, explosions having been produced by the fusion of the lead wires which melt at 300° C. The facility with which mixtures of firedamp and air explode varies with the slightest alteration in their composition; 9½ per cent. of methane is the most readily explosive, and combustion is complete when the proportion of this gas is not below 5.5 per cent. Slight explosions are observed down to 4.5 per cent., but when the solution is greater than this last named figure the results are the same as in pure air. The highest explosive limit is 12 per cent. of methane.

MR. W. M. CATHELS, formerly Superintendent of the Fredericton (N. B.) Gas Light Company, has been appointed Manager of the Brantford (Ont.) Gas Company.

Two Recent Decisions Concerning Riparian Rights.

Engineering Record reports that in 1881 the City of Baltimore constructed a dam across a stream called the Great Gunpowder Falls, about 4 miles below a farm owned by a Mrs. Merryman. The backwater due to the dam extended 800 or 1,000 feet past the lower end of the farm, and resulted, according to the owner, in large deposits in the bed of the stream, which caused the water to overflow the farm and destroy the fences and crops growing on it. The owner accordingly brought an action for damages against the city, which she won in the County Court. The city appealed to the Supreme Court of Maryland, which has recently rendered a decision, 39 Alt. Rep. 98, of considerable interest.

The owner of the farm claimed that the city's negligence in allowing the bed of the stream to remain filled with debris was the cause of the injury to her land. She also alleged that the city was the owner of the bed and banks of the stream and adjoining land on either side for several miles below her property. Evidence was offered tending to prove these claims, and to show that the stream was a foot higher along her land than before the dam was built.

The court states in its decision that the city had no more authority to take a part of the banks of the stream, if it was the plaintiff's property, by covering it with water and keeping it so covered for its own purposes, than it would have to go beyond the bank, excavate the plaintiff's land, flood it with water and use it as the testimony showed other lands were used lower down the stream in making the lake. If a dam had been erected on this property, no one would suppose it could be done without compensating the owner, and the court considered it equally clear that the plaintiff's land, or part of it, could not be taken for the storage of water without just compensation.

The court stated that the testimony tended to establish the plaintiff's claims concerning debris in the bed of the stream, and the negligence of the city in removing it, as the cause of the overflow of the farm. As for the claim that the city was not liable for damages because it was acting under legislative authority in constructing the water works of which the dam is a part, the decision states: "The Legislature has no power to grant such rights to any corporation, public or private. In the familiar case of Pumpelly v. Green Bay Company, 13 Wall., 166, the Supreme Court of the United States, after referring to the doctrine that for a consequential injury to the property of the individual, arising from the prosecution of improvements of roads, streets, rivers and other highways, for the public good, there is no redress, said: 'It remains true that when real estate is actually invaded by superinduced additions of water, earth, sand or other material, or by having any artificial structure placed on it, so as to effectually destroy or impair its usefulness, it is a taking, with the meaning of the Constitution, and that this proposition is not in conflict with the weight of judicial authority in this country, and certainly not with sound principle.' So much of the plaintiff's property, therefore, as is covered by the water would seem to be clearly taken, within the meaning of the constitutional prohibition."

It has been mentioned that the owner of the property did not base her claims on the ground of the decision in the case just referred to, but alleged that the city's negligence resulted in damage to her property. The testimony showed that after the erection of the dam the bed of the stream changed materially. It previously had a hard, rocky bottom, with good current. Now it is filled in many places 3 or 4 feet above the surface of the lake, and some of the deposits are several acres in area. There were 40 or 50 acres of land injured in this way, and evidence was introduced tending to show that the materials settling in the reservoir could be removed by dredging. Hence, even were the city not liable for consequential damages resulting from the mere act of constructing the reservoir, there is evidence of negligence in the maintenance of the improvements. "Municipalities are liable," said the court, "either for negligence in the construction of sewers, drains, culverts, etc., or for the negligent failure to keep them in repair, although they are only intended to carry off surface water within the corporate limits; and why should they not be responsible for negligence in not keeping what was formerly a running stream of water, thus used by them, free from obstructions that force the water on the abutting property? It will not do to argue that the deposits of sand, etc., have not injured the plaintiff, for there is evidence to the contrary." Hence the rulings of the lower court were confirmed and the city ordered to pay the costs of the appeal.

Another somewhat similar recent case is that of Duesler v. City of Johnstown, 48 N. Y. Supp. 683, decided by the New York Supreme Court, Appellate Division. The plaintiff, Elsebra Duesler, was the

owner of about an acre of land, which she bought in 1889. A stream known as Cork Center Creek flowed by this lot on one side, and about 3 miles above this point received a tributary called Cold Brook. About ten years before the land passed into plaintiff's possession, the defendant appropriated the waters of the brook, and settled with the property owners affected by the taking, including the owner of the lot in question. In 1894 the defendant began proceedings to appropriate the waters of Cork Center Creek at a point several miles above the defendant's lot, and in March, 1897, after the action before the court was begun, obtained judgment of condemnation. Pending such proceedings, in July, 1895, the water was diverted from the creek and the flow in the stream past the plaintiff's lot was materially diminished. The action was brought to restrain the defendant from diverting the water, and for damages. The trial court found that the diversion did not affect the value of the land more than $25, and decided that the plaintiff was not entitled to an equitable relief, but had an adequate remedy at law; the case was ordered dismissed unless the plaintiff preferred to accept $25 from the defendant and give a release of her right to have the waters of the creek flow on her land as they did prior to July, 1895. From this decision the case was appealed.

The right to maintain an equitable action to restrain the unlawful diversion of the water of a stream from its natural channel at the suit of a party owning lands on such a channel is well settled, according to the decision of the Supreme Court, and in order to sustain such an action it is unnecessary to show any actual or perceptible damages. "It is only necessary to show a violation of right. The law will presume some damage in such a case." The plaintiff, as the owner of land on Cork Center Creek, took title to the thread of the stream, and acquired the right to the usufructuary enjoyment of the undisturbed flow of the stream. This use was a property right, of which the defendant could not legally deprive her without making due compensation in the manner required by law. The city having acquired no legal right to divert the waters of the creek, the court held that the plaintiff was entitled to a judgment restraining such a diversion. By the act of the defendant, the flow of water on the plaintiff's premises was materially diminished. This result did not follow from the use of the water in an ordinary authorized way, by an owner of land on the stream above the plaintiff, but was caused by taking the water for use in Johnstown, whence it would never return to the channel of the stream.

The fact that the plaintiff purchased the land after the diversion had been effected by the defendant did not prevent her from maintaining the action, in the court's opinion, because the city had not used the water thus diverted for a long enough period to acquire a right to it by prescription.

It was claimed that the damages were not substantial, and that the action therefore fell under the ruling in Gray v. Railroad Co., 28 N.E. 499, which reads: "The amount of damage was thus quite material. Unless the court had found it to be substantial, it, could, in the exercise of its discretion, have witheld the injunction and left the plaintiff to his remedy at law. An equity court is not bound to issue an injunction when it will produce a great public or private mischief, merely for the purpose of protecting a technical or unsubstantial right." This ruling, however, was not in an action for the unauthorized diversion of water, in consequence of which the owner is deprived of his usufructuary right without due compensation. Hence it was held inapplicable to the action under consideration, and the court held to the doctrine enunciated in Rubber Co. v. Rothery, 30 N. E. 842, that "the plaintiff's right to recover damages was substantial, though the quantity of damages was not." The lot in question was worth about $350, while the findings of the trial court showed that the damages, due to a permanent diversion of the water, were $25, one-fourteenth the value of the land. The sum was considered slight by the Supreme Court, but the damages were substantial. Consequently judgment was reversed and the case remanded for a new trial.

Preliminary Note on the Action of Light on Acetylene.

In a presentation of this matter before an ordinary meeting of the English Chemical Society (London, June 16), Messrs. Wm. A. Bone and John Wilson reported that some time ago they noticed that acetylene undergoes a well-marked change on exposure to bright sunlight. Tubes of about 100 c.c. capacity, drawn out at each end and terminated by capillary glass taps, were filled at atmospheric pressure with pure acetylene prepared from copper acetylide, and dried by passing through a concentrated solution of potassium hydroxide. Some of these tubes were exposed on the roof of the laboratory throughout June and July of last year, when the weather was particularly fine. After two or three days' exposure, a faint brown deposit was observable on the inside of the bulbs. This gradually increased in extent and thickness until, at the end of a fortnight, the tubes were entirely covered with a dark brown, greasy deposit. The change was evidently due to the action of sunlight, for if a portion of the tube were screened from the light no deposit was formed over the area so protected, and, further, after the tube had become coated with the opaque deposit no further action was noticeable, even after prolonged exposure. Acetylene was decomposed to a less extent when exposed in tubes during August and September, 1897, than during the previous two months. The decomposition is independent of the presence of air, because acetylene mixed with its own volume of oxygen or nitrogen was exposed to sunlight for a very long period without any appreciable change occurring.

A slight contraction in volume was observed when tubes exposed during last summer were opened over mercury. A measured quantity of the gas sent into a Hempel pipette containing a freshly prepared ammoniacal solution of cuprous chloride was quickly reduced to about 2 per cent. of its original volume. The residual gas, after treatment with dilute sulphuric acid, appeared to contain a fairly dense hydrocarbon absorbed by fuming sulphuric acid, mixed possibly with a small quantity of hydrogen; no saturated hydrocarbon could be detected.

The solid deposit on the side of the tube was removed by treatment with fuming nitric acid, in which it does not dissolve to any appreciable extent. On removal of the acid by filtration, irregular yellow plates remained. The acid filtrate was carefully tested for the presence of nitro-derivatives of benzene and naphthaline, but without success. The yellow plates were insoluble in hot benzene, and could be heated at 270° without melting or undergoing any change; they apparently consisted of a very dense hydrocarbon or hydrocarbons.

The authors are working this summer on larger volumes of acetylene, and hope eventually to determine the nature of the products obtained.

The Molder of the Future and the Need of an Adequate Apprenticeship System.

[A paper read by MR. P. W. GATES, before the last meeting of the American Foundrymen's Association.]

If we are to draw our conclusions of the molder of the future by comparing the molders of the present with those of the past, it becomes evident that steps must be taken to induce young men to embrace this trade who have sufficient education to readily grasp this special line of engineering on different lines than have been followed in the past 20 years; otherwise the business will suffer to such an extent as to make manufacturers untold trouble. We had better molders in the past than at present because foundries, as a rule, were smaller and did a more general class of work. It was often the case that foundries employing not more than 10 or 12 molders manufactured plows, stoves, printing presses, water wheels, stationary and marine steam engines, saw and grist mill machinery, reapers, mowers, threshing machines, etc. The young man who was fortunate enough to serve an apprenticeship in such a place certainly gained a general knowledge that stood him well in hand wherever he went. But the growth of this business in America has been so rapid that it has brought about the specializing of the different branches, and in doing this at once destroyed the opportunity of making the same high grade mechanics as were turned out in the general foundries.

This specializing is carried to such an extent that in hiring a molder now it becomes necessary to ask him what line of work he is accustomed to, while in the past the bare statement that the applicant was a molder carried with it that he could make any class of work. I have heard it argued that specializing must continue until finally there will be shops making nothing but cylinders, others making nothing but engine frames, others nothing but flywheels, and that it will not be necessary to have apprentices, because common laboring men can soon be schooled to make any one piece cheaper and more perfect. I cannot take this view but believe that the general foundry will always occupy the largest place, at least in number, and to my mind the molder of the future must be different from the foregoing. He must have a good education, to begin with, so as to be able to study properly the material he is using. In the future pig iron and other materials will be known by their properties; hence the ignorant boy who formerly made a fairly good molder will have no place in the strictly modern foundry of the future.

Speaking now of apprentices in general, for all branches are equally affected, I think it will be conceded without much argument that the more intelligent a class of mechanics becomes the higher the standard of

the work which they produce and the higher the moral tone and self-respect of such class. It seems to me necessary for the foundrymen and manufacturers to encourage and employ apprentices for the sake of supplying the places of journeymen who fall out of the ranks through sickness, death, etc., and to supply the necessary molders for new industries. It therefore seems desirable to me that young men of education be induced to seek this vocation as a means of livelihood. If this is the fact, the question then arises as to how we may secure such apprentices.

The experience in our works has been that it is very difficult to induce young men who have passed the grammar schools, or schools of equal or higher standard, to embark in the molders' or other trades. There seems to be no difficulty in getting plenty of applicants of an uneducated class, but our experience in the past has been that this class is not willing to submit to the necessary discipline and that it is usually dull and slow to learn. On the other hand, we have found that where we could get applicants who had been through the grammar schools, or other equally good schools, they appreciated the fact that discipline must be enforced, were always willing to live up to the rules, were anxious to advance themselves, and were students in their new vocation.

Having acquired the habit of study, we find that they apply the same thought to their work, can readily grasp the instructions given by the foreman, and are not satisfied with merely getting through with their work as a stint, but study the conditions and take great pride in the character of work which they are turning out. From this experience we have reached the conclusion that we shall try to confine ourselves to a class of apprentices who have at least reached as high a standing as to pass the sixth grade in the public grammar schools, and, if possible, who have graduated from the grammar school or some school of equal standing with the public schools of our city.

In casting about for the reason why we do not have applicants from this class of young men for apprenticeship we reached the conclusion that the inducements offered are too small and therefore concluded to offer a better scale of wages and inducements, for several reasons. First, in many instances the parents of would be applicants of this kind are mechanics who have had a great struggle to give their children the benefit of a grammar school education, and who, having other children coming along who are gradually absorbing more of their means, feel that as soon as the boy has passed the public school he should be in condition to be self-supporting. They cannot, therefore, afford to contribute much if any toward the support of the boy for a further term of two or three years while he is passing through the earlier stages of his apprenticeship.

On the other hand, it is natural, and in one sense creditable to the boy, that he should wish to be self-supporting, and also only natural that he should desire to earn enough so that he may have some small amount of spending money. These desires we think often blind the boy, and perhaps the parent as well, to the reward following apprenticeship. The possibility that the boy may find some employment which will earn him something like $1 or even $1.50 a day at once, although it may be nearly as high an amount of wages as he will ever reach, decides him to go in another direction.

I know a number of young men who attended public school with me when a boy who are to-day in positions such as street car drivers, conductors, teamsters, etc., who I remember as bright boys in their studies. Some of them have told me that the mistake of their life was that they did not learn a trade, and I feel sure that some at least would have been able to have earned much more money than they are now earning, and perhaps been high in the offices of some good institution, had they learned a trade thoroughly.

I am sometimes inclined to agree with a friend who once asserted that no one ever learns anything from experience; but be that as it may, young people are slow to profit by the experiences of others, and since the fact remains that we do not seem to get many applications from desirable apprentices, we set the foregoing reasons down as being responsible for the fact, and adopted the following standard:

We refuse to take any applicant who is not to appearances physically sound, cannot bring good recommendations as to character, has not passed through the public schools at least as far as the sixth grade, or of some equivalent educational institution, and is willing to serve three months on trial before signing articles for a four years' apprenticeship, the three months of trial, however, being counted as so much time on the first year.

A year is to consist of 300 days of 10 hours each, and for the first year we pay 7½ cents per hour, or $4.50 per week; the second year we pay 10 cents per hour, or $6 per week; the third year we pay 12½ cents per hour, or $7.50 per week; the fourth year we pay 15 cents per hour, or $9 per week, where the weeks consist of 60 hours, and it is our policy to give the apprentices full weeks, even if the machinery is not running, by placing them at such times on work that can be done without the use of power.

This scale of wages was made with the idea that it would be nearly if not quite the equivalent that any would-be applicant would have offered if he were going out to find work of a general character, and would therefore be attractive to applicants. And we offer a further inducement in the fact that we agree to give each apprentice at the end of his apprenticeship the sum of $100 as a bonus for faithful performance of the contract entered into between us. We are of the opinion that from an economic standpoint we might do better with journeymen at journeymen's wages; but we also believe that it is a duty which we owe to ourselves and to the manufacturing fraternity to keep up an apprenticeship system which will develop good journeymen, and we feel that if we do this, and other manufacturers do it, we shall be able to supply ourselves in the future with mechanics of such class as will be better qualified for the work demanded of them, and in this manner be indirectly repaid for the outlay.

We require of our apprentices that they attend night drawing school, so that they may become competent to make ordinary sketches and help them to learn how to read drawings, and it is our policy to interest ourselves in these matters to a large extent in order to encourage the boys in the greatest degree. I am pleased to say that we always find the class of apprentices of which I have been speaking not only willing, but anxious to avail themselves of such facilities, and that the foremen take great interest in such cases and are always willing to help the good work along.

Not only has our experience with apprentices who have passed the sixth grade of public schools been satisfactory, but in instances where we have had apprentices who are graduates of the technical or training schools we have found their progress rapid and their ability equally greater, and for this reason we place such graduates in a separate class, offering them apprenticeship positions which omit the first year's work and start them on the second year. We feel that we can do this for two reasons—namely, they have, through the practice received at the training schools, acquired some ability, which lessens the amount of attention they need from the foreman, and, second, a superior educational training and discipline incident thereto fit them to progress faster and accomplish the same results, or better, in the shorter time. The Western Foundrymen's Association adopted a form of agreement for apprentices in which some such distinction was made, but for some reason it has never been put into active operation by the members.

It seems very essential to me that the apprenticeship matter should be given careful consideration by this Association if we have any regard for the molder of the future, and that it should be the duty of every manufacturer to increase his apprentices to the fullest extent consistent with circumstances. In our machine shop we employ 14 apprentices, in our millwright shop 1, our pattern shop 1, and in our foundry 10, and it is our policy to immediately put in a new apprentice as often as an old one drops out, because we advise all our apprentices as soon as their time is out not to remain in our shop, but to go out and get the benefit of experience from other shops, believing that sooner or later a certain number of them will return to us more efficient workmen than ever.

There is one other matter which I might with propriety call to your attention in this paper—namely, the advisability of co-operating with the training schools in the conduct of their workshops. In talking with the Principal of the Lewis Institute, of Chicago, on this matter, I asked him whether it would be of advantage to him if a committee from the different branches of manufacturing would call at the Institute, say once a month, and inspect the work going on in the shops, and offer such suggestions as would seem to make the work practical and available for use in such manufactories when the students were out of school. He informed me that he should hail such an arrangement with delight, and that it would be of the greatest benefit to both the faculty and scholars.

It seems to me, therefore, in such light that it is the duty of Associations to take up such matters, since committees of this kind, drafted out of members of Associations, would not entail a hardship on any manufacturer, would cause regular attendance and would be of the greatest benefit to all concerned.

It is possible that such matters had better be left to the local organizations throughout the country, but as most of the members of this Association are members of some local organization, it may not be amiss to mention the matter here.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE right of the Jefferson Gas Light Company to light the Sixth and Seventh districts of the city of New Orleans, expires March 9th, 1899. After the time noted the exclusive right to make and vend gas in the districts named reverts to the New Orleans Gas Light Company.

THE Peoples Light and Power Company, of Jersey City, N. J., is erecting a new boiler house in connection with its electric plant. The building, which is a modern structure in every respect, is 60 feet wide, and about 90 feet in length, and contains ample space for large, upright boilers. It is planned for the storage of coal in the steel bunker inside the building, so that the fuel can be easily taken direct to the boilers. The tracks are arranged so that railroad cars will run directly into the building and discharge the coal into the bunker. The building is of fireproof construction throughout, with steel frame, brick side walls and iron roof covering, well lighted and ventilated. The steel work is being furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn. Messrs. Sandford & Stillman, of Jersey City, have the contract for the building.

THE Detroit City (Mich.) Gas Company has notified the residents that it will continue to run services and make free connections in the matter of a gas supply to cooking and heating apparatus up to August 15th.

THE Milford Gas Company, to operate in Milford, Pa., has been incorporated. It is capitalized in $10,000. This is likely an extension of the acetylene gas scheme for Milford, mention of which was made in our issue of the 4th inst.

THE following report rendered by the Special Committee of the City Council, of Memphis, Tenn., in respect of permitting a consolidation of the gas interests of Memphis, seems to foreshadow the end of the long gas strife in that city :

"We, your Committee appointed by your honorable body to take under advisement the condition of the two gas companies of the city of Memphis and their relations to the city, beg leave to make the following report :

"We would recommend that the two gas companies be permitted to consolidate under one of their charters, or under a new charter, the name and style of the Company to be hereafter agreed upon, and that a contract between such Company and the city of Memphis be drawn, embracing the following conditions, to wit :

"That from and after the date of the contract, to be entered into by and between the city of Memphis and the Gas Company, the Gas Company shall furnish 20-candle power, pure gas light.

"That it is now ascertained that the output of these two Companies combined is 100,000,000 cubic feet per annum.

"That the price of gas for illuminating purposes shall be $1.50 per 1,000 cubic feet. That the price of gas for culinary, heating and mechanical purposes shall be $1.25 per 1,000 cubic feet.

"That as the business of the Gas Company increases from time to time, the price of gas, both for illuminating and mechanical purposes, shall be reduced 5 cents per 1,000 cubic feet for every additional 10,000,000 cubic feet used for both illuminating and mechanical purposes, until the price of gas is reduced from time to time by the increase of consumption at the rate of 10,000,000 cubic feet, until the price of both or either shall not exceed $1 per 1,000 cubic feet.

"In order to satisfy, liquidate and pay the $50,000 liquidating damages conditioned in the contract of the Equitable Gas Company, should the two Gas Companies at any time ever consolidate, the city is to take $5,000 worth of gas (of 20-candle power) each year, at $15.75 per gas post, until the entire $50,000 is paid.

"The Gas Company is to erect and connect the gas posts in the city, furnish supplies and gas for same and keep them clean. The city is to do the paving wherever the streets are torn up to make those connections.

"The Gas Company is to extend its mains from time to time, wherever and whenever the legislative council so orders, provided such extensions shall not work a hardship upon the Gas Company.

"These extensions and erections of gas posts to be made within the old city limits and the annexed territory, and any territory that may hereafter be annexed. The other details and verbiage of the contract to be discussed and agreed upon between the Gas Company and the legislative council, upon the final adoption of the contract, as contemplated.

"Your Committee believe that this will be fair and equitable to both gas companies, and result in a saving of about $40,000 to the general public the first year, and more each succeeding year, and will give the gas companies time and opportunity to pay the liquidating damages for which the Equitable Gas Company is liable under its contract ; and by this contract the two Gas Companies will be enabled to better their financial condition and redeem the enterprises, which are now in a languishing condition.

"Trusting that these recommendations of your Committee will meet the approbation, not only of the legislative council, but also the wishes and demands of the public generally.

"D. P. HADDEN,
"THOS. CLARK, } Committee."
"A. T. HAYDEN,

IN connection with this report it is further specified that the right to contest for the rate of $1.50 per 1,000, as against the $1.75 charge made by the companies for some time back, is reserved to the consumers.

THE proprietors of the Binghamton (N. Y.) Gas Company have awarded to the Western Gas Construction Company a contract for the placing of a single set of 7 feet 6 inches double superheater water gas apparatus, the installation to include connections for reversed steam supply, and a coal elevator, similar to that constructed by the Construction Company at Milwaukee, Wis., some two years ago.

AT the annual meeting of the Mankato (Minn.) Gas and Electric Light Company the Directors chosen were : J. B. Meagher, L. Patterson, R. E. Brown, M. K. Meagher, H. A. Patterson, F. K. Meagher, E. W. S. Tingle and K. F. Meagher.

THE Detroit (Mich.) City Gas Company has finally arranged for permanent office headquarters in the Ferguson building, 230-232 Woodward avenue. The premises will be suitably fitted up for the purposes of the Company, and the plan of change embraces a showroom for the display of current day gas appliances. The Company will take possession September 1st.

THE Board of City Gas Trustees, Wheeling, West Va., is considering a proposition to increase the wages of the employees of the gas works.

AT the annual meeting of the Milwaukee (Wis.) Gas Light Company the officers chosen were : Directors, Emerson McMillin, J. P. Murphy, W. Becker, F. G. Bigelow, A. E. Smith, B. M. Weil, S. M. Green, Ed. G. Cowdery and H. C. Payne ; President, Emerson McMillin ; First Vice-President, B. M. Weil ; Second Vice-President, S. M. Green ; Secretary and Treasurer, S. J. Glass ; General Manager, E. G. Cowdery.

THE proprietors of the Gas Company of Luzerne County, Pa.—the Company which has taken over the hitherto separate gas companies of Wilkes-Barre—in their official announcement of the gas rate that is to rule under their management, say : "The Board of Directors of the Gas Company of Luzerne County have fixed the price of gas in this city at a uniform rate of $1.10 per 1,000 cubic feet. If bills are paid at the office of the Company, on or before the 15th of month succeeding date of bill, the following discounts will be allowed : On bills less than $50, 1 cent per 100 cubic feet ; on bills of $50 or more, 2 cents per 100 cubic feet."

AT the annual meeting of the shareholders in the Louisville (Ky.) Gas Company the Directors chosen were: George W. Morris, John M. Atherton, H. V. Loving, Jas. B. Speed and John Stites. The joint Council of Louisville named the following Directors to represent the city on the Company's Board : John Doerhofer, W. J. Abrams, T. Hunt Stucky and George Gaulbert. Looking it all over, it seems that the "reform element" is not quite so strong in "Kaintucky" this year as it was a twelvemonth ago.

A MYSTERIOUS incorporation was recently made in Camden, N. J. By virtue of the papers filed, the Knickerbocker Gas Company was created, with the object of making and selling gas. The concern is capitalized in $500,000 ; but only the sum of $1,000 has been paid therein. The incorporators are said to be Wilson Waddingham, Edward P. Baker and Geo. H. B. Martin.

AT the annual meeting of the Burlington (Vt.) Gas Light Company the result reached was : Directors, B. B. Smalley, F. H. Wells, A. G. Pierce, U. A. Woodberry and R. G. Severson ; President, R. B. Smalley ; Vice-President, A. G. Pierce ; Secretary, Treasurer and Superintendent, F. H. Parker.

(*Continued on page* 93.)

THE AMERICAN GAS LIGHT JOURNAL

MONDAY, JULY 18, 1898.

(*Continued from page 92.*)

THE authorities of Fort Atkinson, Wis., would like to have a gas works operating in their "midst." As they are coquetting with an acetylene proposition they stand a fair chance to gain their aim.

THE proprietors of the Torrington (Conn.) Electric Light Company have virtually decided to establish a gas annex; which decision betokens a desire to help themselves out.

MR. H. V. M. DENNIS, President of the Freehold (N. J.) Gas Company, has submitted a proposition to the local authorities for the lighting of the streets by means of improved Welsbach lamps. The Company agrees to maintain the lamps on the basis of an annual payment of $27.50 per post.

The Market for Gas Securities.

The market for city gas shares is still in a state of lethargy, although prices in the main are fairly firm. Consolidated opened to-day (Friday) at 197¼ to 197½, but the trading was of the lightest description. Standards remain at the figures of last week. Brooklyn Union was in some demand at better rates than those recently quoted. To-day the figures are 123½ to 124. Peoples, of Chicago, was notably weak, and Western, of Milwaukee, also developed a downward tendency. Baltimore Consolidated more than maintains its recent advance, the bid rate being 64¾. Bay State, presumably on the likelihood that the Board of Gas and Electric Light Commissioners of Massachusetts would assent to the issue of $1,000,000 stock by the Massachusetts Pipe Line Company, sold down to 3. Lacledes are steady. Buffalo City gas is 24 bid.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

JULY 18.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	197¼	197½
Central	500,000	50		..
" Scrip	220,000	..	100	.
Cental Union, Bonds, 5's	3,000,000	1,000	99½	100
Equitable	4,000,000	100	206	215
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	,500,000	100	325	335
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co.	13,000,000	100	31¼	31½
Preferred	10,000,000	100	75¼	76
Bonds, 5's	11,000,000	1,000	102⅝	102⅞
Northern	150,000	50	..	.
" Bonds	150,000	1,000	..	
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River	5,000,000	100	81	84
Preferred	2,000,000	100	112	115
Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	108	108¾
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	138	140
Preferred	5,000,000	100	152	158
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	123½	124
" " Bonds (5's)	15 000,000	1,000	114	115
Bay State	50,000,000	50	3¼	3¼
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	92
2d " " "	3,000,000	1,000	70	..
Buffalo City Gas Co.	7,000,000	100	24	25
" " Bonds, 5's	7,000,000	1,000	96	97
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,000,000	.	80	91
1st Mortgage	1,085,000	..	101	103½
Consumers. Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	100	103¾
Cincinnati G. & C. Co.	8,500,000	100	202	203
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	64¾	65
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000		58	58½
" Con. Bonds	4,312,000	..	94¼	95
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	91
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	85
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	50	50¼
Preferred	2,500,000	100	91	93
Bonds	9,034,400	1,000	..	105
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	97⅞	98
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	17	18
Bonds	1,000 000	..	94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	85¼	86
Bonds, 5's	3,556,000	.	101¾	102¼
Wilmington, Del.	350,000	50	200	

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	111
Fred. Bredel, Milwaukee, Wis	98
Geo. R. Rowland, New York City	111
The Western Gas Construction Co., Fort Wayne, Ind	100
Humphreys & Glasgow, New York City	104
American Gas Co., Phila., Pa	98
David Leavitt Hough, New York City	113
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	111
Baxter & Lynn, Detroit, Mich	97

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md	109
United Gas Improvement Co., Phila., Pa	103
Burdett Loomis, Hartford, Conn	110
National Gas and Water Co., Chicago, Ills	105
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	111
The Western Gas Construction Co., Fort Wayne, Ind	100
Humphreys & Glasgow, New York City	104

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	112
Continental Iron Works, Brooklyn, N. Y.	110
Deily & Fowler, Phila., Pa	112
Kerr Murray Mfg. Co., Fort Wayne, Ind	108
Stacey Mfg. Co., Cincinnati, Ohio	111
Bartlett, Hayward & Co., Baltimore, Md	109
Davis and Farnum Mfg. Co., Waltham, Mass	108
R. D. Wood & Co., Phila., Pa	110
Isbell-Porter Company, New York City	110
Fred. Bredel, Milwaukee, Wis	98
United Gas Improvement Co., Phila., Pa	103
Berlin Iron Bridge Co., East Berlin, Conn	94
National Gas and Water Co., Chicago, Ills	105
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	111
The Western Gas Construction Co., Fort Wayne, Ind	100
Humphreys & Glasgow, New York City	104
Gas Engineering Co., Pittsburgh, Pa	108
American Gas Co., Phila., Pa	98
Logan Iron Works, Brooklyn, N. Y.	112
Riter-Conley Co., Pittsburgh, Pa	104
Baxter & Lynn, Detroit, Mich	97

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	111
R. D. Wood & Co., Phila., Pa	110
James R. Floyd's Sons, New York City	112
Continental Iron Works, Brooklyn, N. Y.	110
Gas Engineering Co., Pittsburgh, Pa	108
Logan Iron Works, Brooklyn, N. Y.	112
Riter-Conley Co., Pittsburgh, Pa	104

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	111
R. D. Wood & Co., Phila., Pa	110

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich	94
G. Shepard Page's Sons, New York City	111
Gas Engineering Co., Pittsburgh, Pa	108

GAS METERS.

John J. Griffin & Co., Phila., Pa	80
American Meter Co., New York and Philadelphia	115
Helme & McIlhenny, Phila., Pa	115
D. McDonald & Co., Albany, N.Y.	113
Nathaniel Tufts Meter Co., Boston, Mass	114
Maryland Meter and Mfg. Co., Baltimore, Md	114
Metric Metal Co., Erie, Pa	114
Keystone Meter Co., Royersford, Pa	114
Detroit Meter Company, Detroit, Mich	115

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	115
John J. Griffin & Co., Phila., Pa	80
D. McDonald & Co., Albany, N. Y.	113
Helme & McIlhenny, Phila., Pa	115

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	113
M. J. Drummond, New York City	113
R. D. Wood & Co., Phila., Pa	110
Warren Foundry and Machine Co., New York City	113
Donaldson Iron Co., Emaus, Pa	113
Utica Pipe Foundry Co., Utica, N. Y.	113

PIPE CUTTERS.

The Anderson Pipe Cutter Co., East Boston, Mass	97

PIPE JOINTS.

Bayles Engineering Co., New York City	95

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	105

GAS COALS.

Penn Gas Coal Co., Phila., Pa	107
Perkins & Co., New York City	106
Despard Gas Coal Co., Baltimore, Md	107
Westmoreland Coal Co., Phila., Pa	107
Berwind-White Coal Mining Co., New York and Phila	106
W. D. Althouse & Co., Phila., Pa	107

CANNEL COALS.

Perkins & Co., New York City	106
W. D. Althouse & Co., Phila., Pa	107
Greasy Creek Cannel Coal & Tramway Co., Chicago, Ills.	95

GAS ENRICHERS.

Standard Oil Co., New York City	107
The Sun Oil Co., Pittsburgh, Pa	107

COKE CRUSHER.

C. M. Keller, Columbus, Ind	107

GAS GAUGES.

The Bristol Co., Waterbury, Conn	93

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 105
Isbell-Porter Co., New York City 110
R. D. Wood & Co., Phila., Pa 110
Wm. M. Crane & Co., New York City 58

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y. 96

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J. 96
B. Kreischer & Sons, New York City 96
Adam Weber, New York City 96
Laclede Firebrick Mfg. Co., St. Louis, Mo. 96
Cyrus Borgner, Phila., Pa 96
James Gardner, Jr., Pittsburgh, Pa 96
Henry Maurer & Son, New York City 96
Baltimore Retort and Firebrick Co., Baltimore, Md. 96
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 96
Brooklyn Firebrick Works, Brooklyn, N. Y. 96
F. Behrend, New York City 97

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. 109
Fred. Bredel, Milwaukee, Wis. 98
J. H. Gautier & Co., Jersey City, N. J. 96
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 96
Adam Weber New York City 96

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City 110
Continental Iron Works, Brooklyn, N.Y. 110
G. Shepard Page's Sons, New York City 111
Logan Iron Works, Brooklyn, N. Y. 112
R. D. Wood & Co., Phila., Pa. 110

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa. 102
Victor Incandescent Company, New York City. 95
Hugo Cahen, Berlin, Germany 95

MICA GOODS.

The Mica Mfg. Co., New York City 95

BURNERS.

C. A. Gefrorer, Phila., Pa. 110
Wm. M. Crane & Co., New York City 58

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. 94

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila. 104

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 105
Greenpoint Chemical Works, Brooklyn, N.Y. 97
Henry W. Douglas, Ann Arbor, Mich 105
Gas Purification and Chemical Co., Ltd., London 105

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind 99
Isbell-Porter Company, New York City 110
Connelly Iron Sponge and Governor Co., New York City 105

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y. 100
Chapman Valve Manufacturing Co., Boston, Mass. 100
R. D. Wood & Co., Phila., Pa. 110
Continental Iron Works, Brooklyn, N. Y. 110
The P. H. & F. M. Roots Co., Connersville, Ind. 99
Isbell-Porter Co., New York City 110
The Western Gas Construction Co., Fort Wayne Ind. 100

ELECTRICAL APPARATUS.

Wm. Henry White, New York City 111

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa. 116
Backus Water Motor Co., Newark, N. J. 94

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City. 97
W. G. & G. Greenfield, East Newark, N. J. 94

PURIFIER SCREENS.

John Cabot, New York City 95

GAS STOVES.

American Meter Co., New York and Philadelphia 101
Maryland Meter and Manufacturing Co., Baltimore, Md. 114
Keystone Meter Co., Royersford, Pa. 114
Wm. M. Crane & Co., New York City 58
The Schneider & Trenkamp Co., Cleveland, Ohio 59

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y 100

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 109
Continental Iron Works, Brooklyn, N. Y. 110
Deily & Fowler, Philadelphia, Pa. 112
Davis & Farnum Mfg. Co., Waltham, Mass. 108
Kerr Murray Mfg. Co., Fort Wayne, Ind. 108
Stacey Mfg. Co., Cincinnati, Ohio 111
R. D. Wood & Co., Philadelphia, Pa. 110
Logan Iron Works, Brooklyn, N. Y. 112
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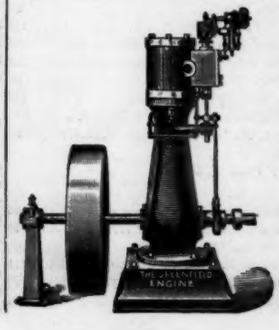

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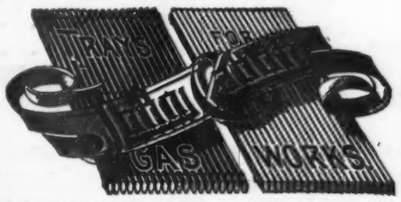

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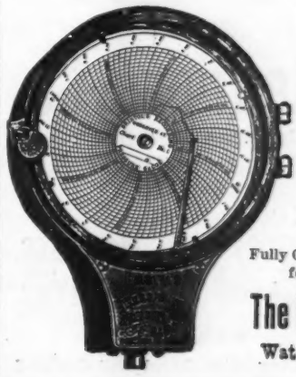

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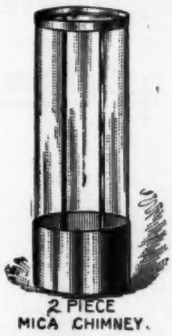

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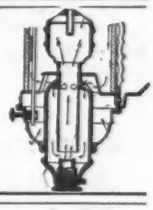

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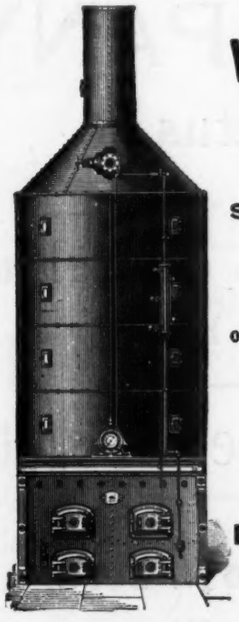

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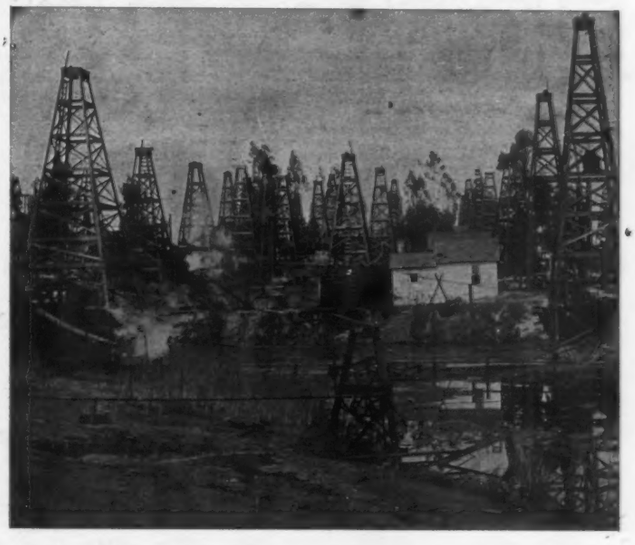

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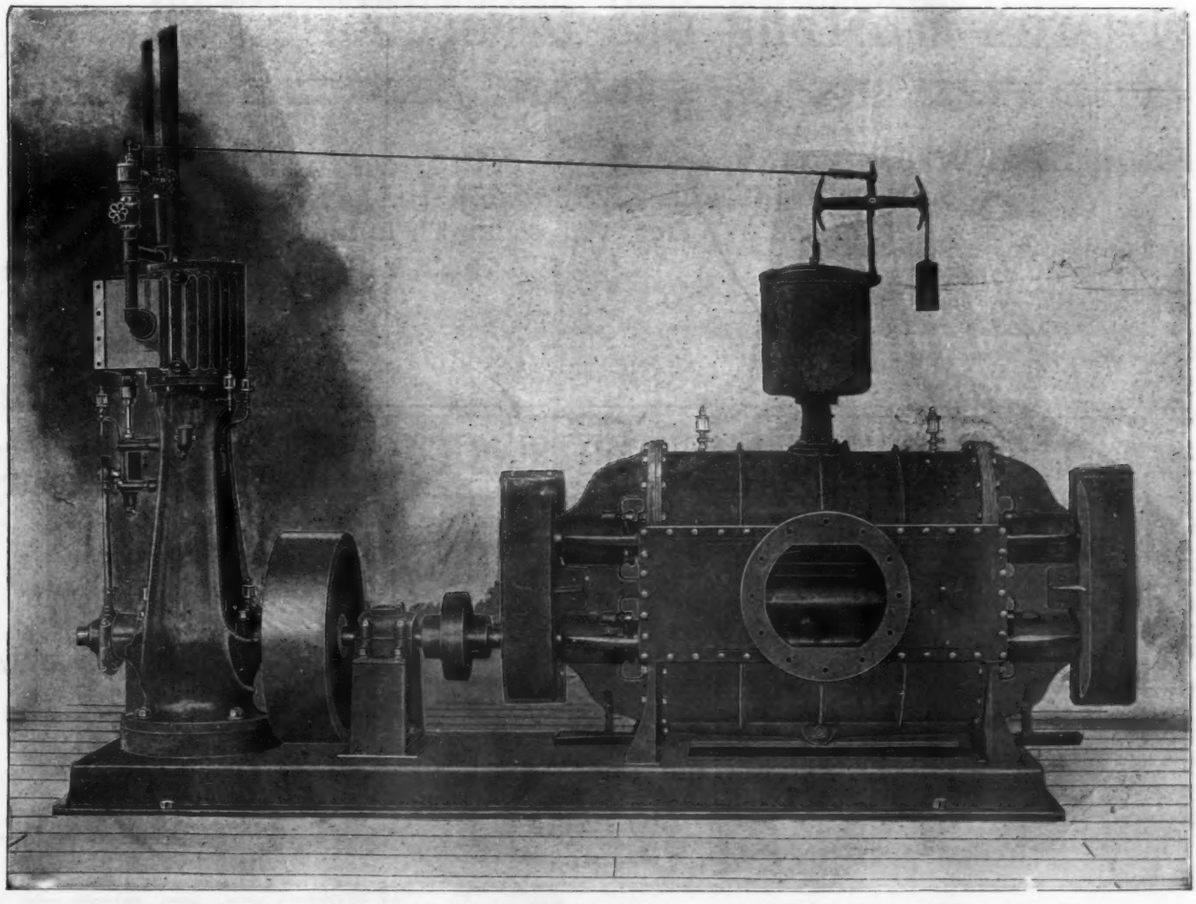

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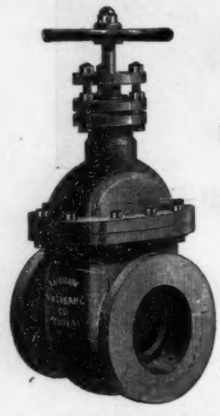

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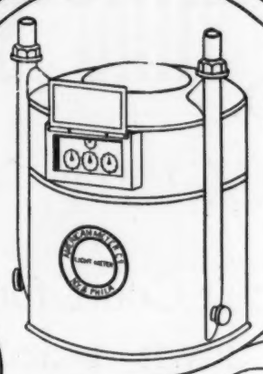

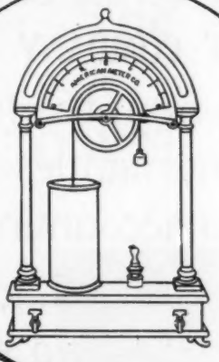

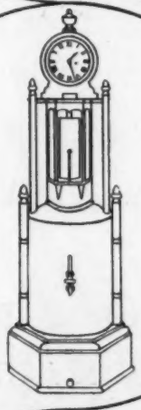

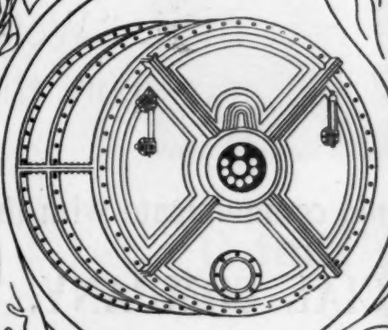

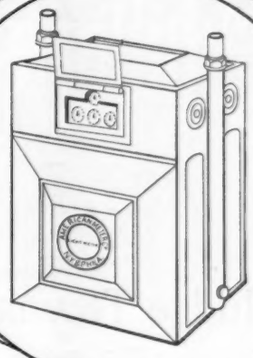

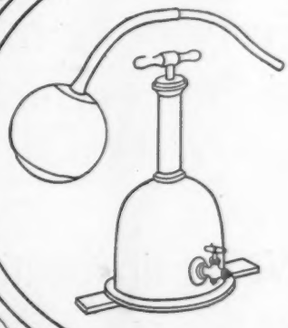

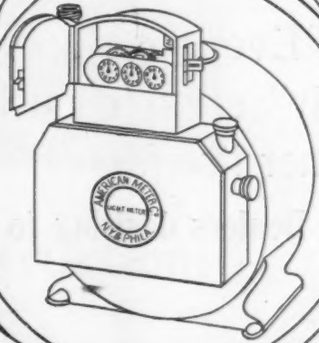

PUBLIC LIGHTING TABLE.

AUGUST, 1898.

Day of Week.	Table No. 1. FOLLOWING THE MOON.			Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING.	
	Date.	Light.	Extinguish.	Light.	Extinguish.
				P.M.	A.M.
Mon.	1	No L. FM	No L.	7.10	3.30
Tue.	2	No L.	No L.	7.10	3.30
Wed.	3	7.40 PM	9.00 PM	7.10	3.30
Thu.	4	7.40	9.20	7.10	3.30
Fri.	5	7.40	9.50	7.10	3.30
Sat.	6	7.40	10.20	7.10	3.45
Sun.	7	7.30	10.50	7.10	3.45
Mon.	8	7.30 LQ	11.20	7.10	3.45
Tue.	9	7.30	12.00	7.10	3.45
Wed.	10	7.30	12.40 AM	7.10	3.45
Thu.	11	7.30	1.30	7.10	3.45
Fri.	12	7.30	2.20	7.10	3.45
Sat.	13	7.30	3.20	6.55	4.00
Sun.	14	7.20	4.10	6.55	4.00
Mon.	15	7.20	4.10	6.55	4.00
Tue.	16	7.20	4.10	6.55	4.00
Wed.	17	7.20 NM	4.10	6.55	4.00
Thu.	18	7.20	4.10	6.55	4.00
Fri.	19	7.20	4.10	6.55	4.00
Sat.	20	7.20	4.10	6.45	4.10
Sun.	21	7.20	4.20	6.45	4.10
Mon.	22	8.00	4.20	6.45	4.10
Tue.	23	8.40	4.20	6.45	4.10
Wed.	24	9.30 FQ	4.20	6.45	4.10
Thu.	25	10.20	4.20	6.45	4.10
Fri.	26	11.30	4.20	6.45	4.10
Sat.	27	12.40 AM	4.20	6.30	4.20
Sun.	28	2.00	4.30	6.30	4.20
Mon.	29	3.20	4.30	6.30	4.20
Tue.	30	No L.	No L.	6.30	4.20
Wed.	31	No L FM	No L.	6 30	4.20

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Patent Sustained.

INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

We again caution gas companies and the public generally against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

Dealers desiring to handle the genuine article should communicate with the

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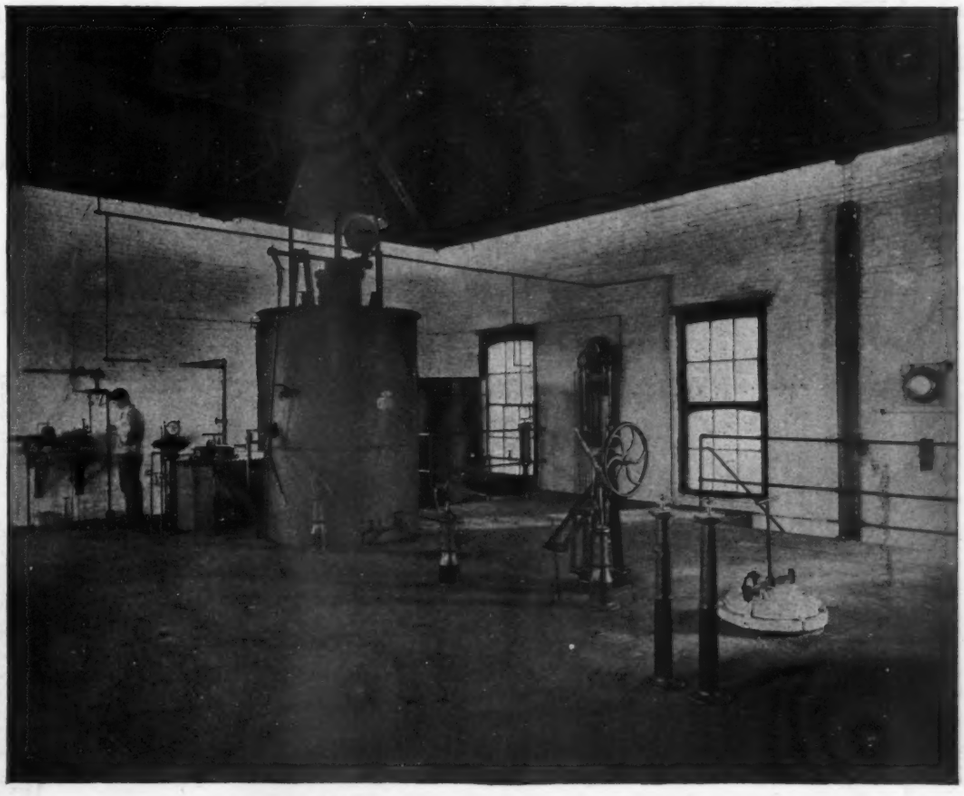
DREXEL BUILDING, PHILA., PA.

The Standard Junior,

The Standard Double Superheater,

LOWE WATER GAS APPARATUS.



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Where there are no gas mains already laid, we can furnish an equally good light by our **SELF-GENERATING NAPHTHA WELSBACH BURNER,** enabling Gas Companies to furnish a uniform light in all localities.

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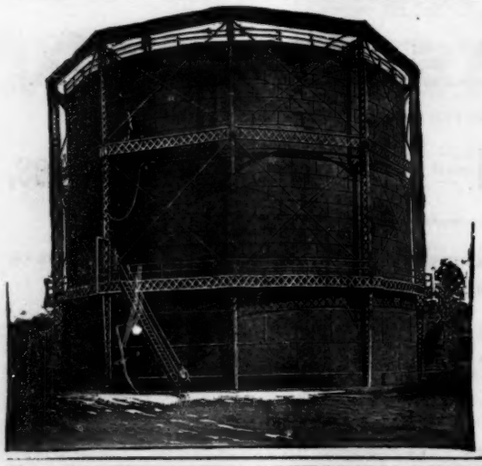

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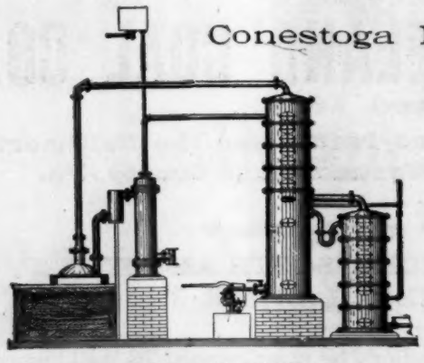

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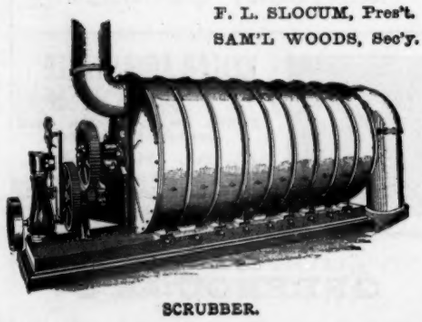

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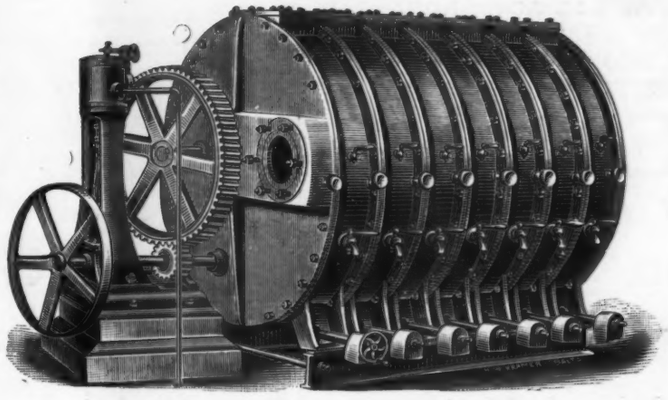

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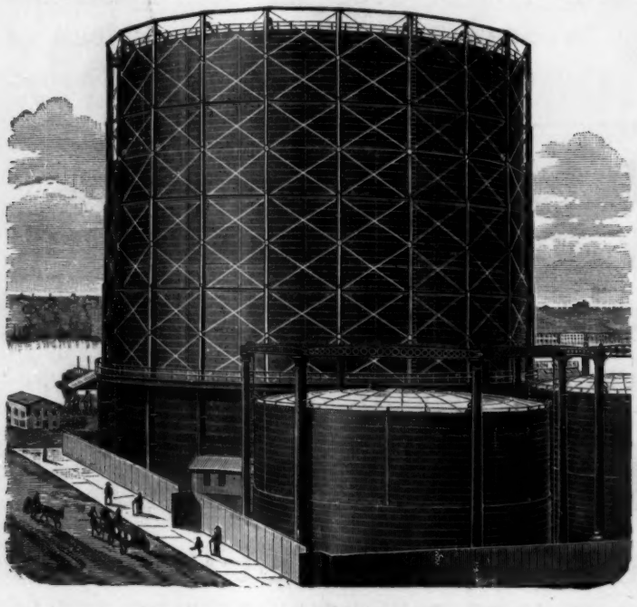

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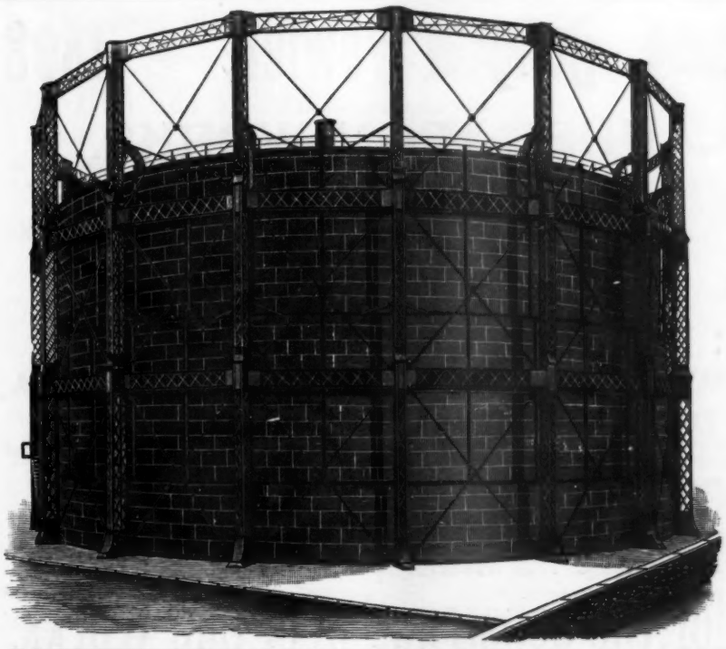

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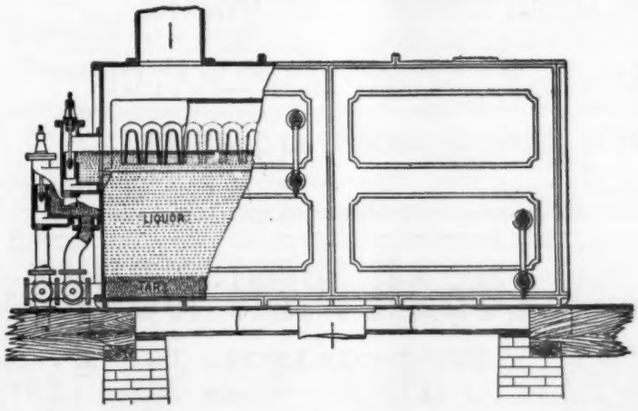

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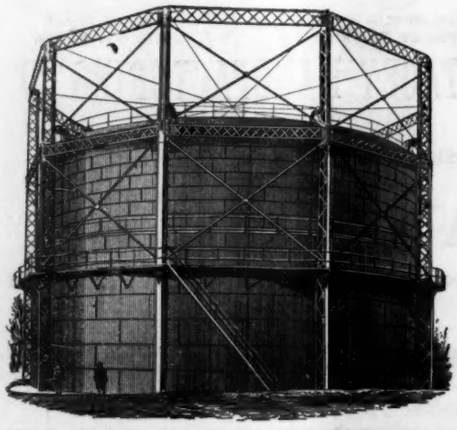

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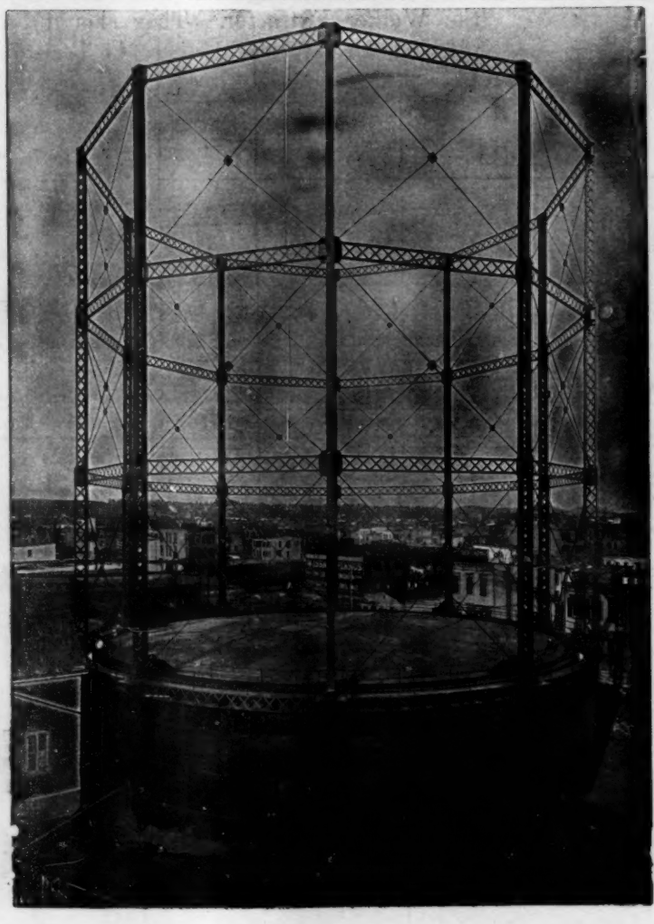

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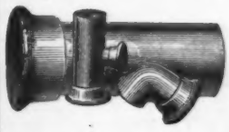

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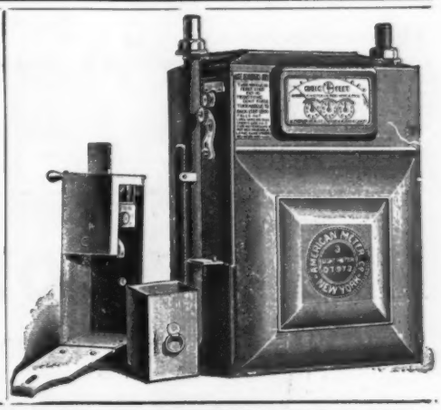

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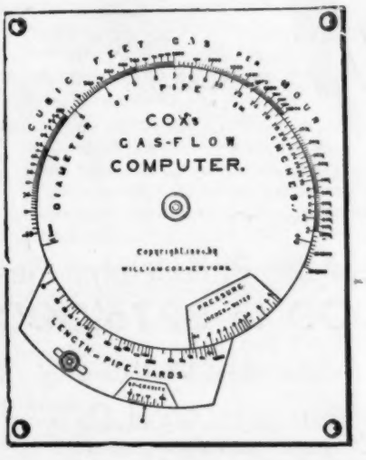

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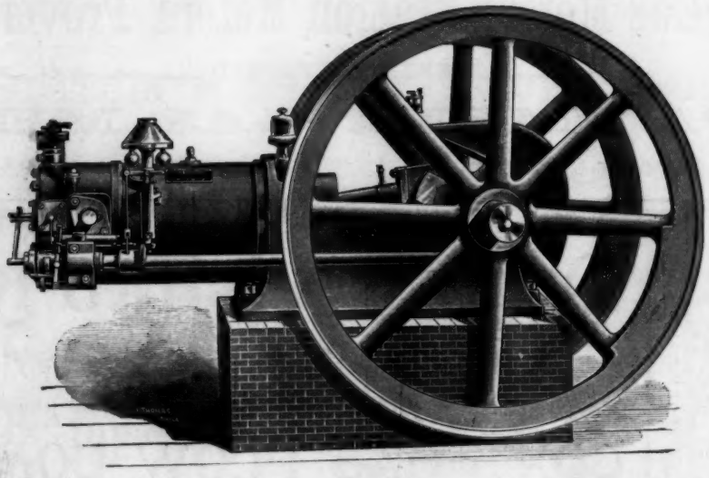

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